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MASTER PROGRAM IN

ENERGY MANAGEMENT AND ENVIRONMENTAL PROTECTION

EMISSION MARKET AND RISK MANAGEMENT

By

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Abstract

In the context of reducing CO2 emissions, avoiding climate change and global warming, the Kyoto Protocol was signed in 1997, which contains legislative commitments and obliges 37 developed economies to reduce emissions of greenhouse gases. . Corresponding policies are followed by European countries, but also by several large economies. Under these conditions, the exchange of carbon credits is allowed, which has led to the creation of a new market, the market for emission allowances (emission unit). But at the same time with the emerging environmental market, the already developed energy market pre-existed. But after 9/11, the world changed as US aggression against oil-producing countries in the Middle East and the Enron energy scandal, combined with the deep economic crisis of recent years, created a greater market interest in the field of energy derivatives. This work provides an overview of the above markets and due to the specificity of the environmental market and the intense volatility of fuel prices, methods of environmental and energy risk management will be applied.

Keywords: emission markets, climate change, greenhouse gasses, risk management

CONTENTS

CHAPTER 1

1.1 Global Warming- Climate Change-Climate Crisis

When discussing the environment, we usually come across with three terms. Global warming, climate change, climate crisis. All of them are legitimate and there is a history behind them and specific reasons for which they were brought into our everyday life.

We started with 'global warming' in order to define how humans through their intervention increased the temperature of the planet. In the meantime, humankind became almighty and big, hence, unbearable to the comparatively weaker planet. Planet had to endure the demands of our economic system, of our society and our consumerism. When climate variability got into the discussion the term 'climate change' appeared, evincing both natural and human interventions as well as the consequences of this climate change. Finally, we have the term 'crisis' which puts the following question on the table: Do we have time to reserve what is happening now?

It is important to understand what 'crisis' means. It's a human crisis. The climate changes, the conditions on the planet change. What is crucial, is that humankind and the biodiversity surrounding us, won't be able to survive on this planet. The planet itself can survive under more extreme weather conditions. It is important to understand that this crisis affects humankind's chances of surviving on this planet.

Nowadays, it considers a crisis for it seems that although we have the technology and money needed for preventing the temperature from increasing by three or four Celsius degree, if this isn't done within the next ten years then the consequences will be detrimental and harmful for millions of people. So, it's a crisis because we have very little time to change the course of the things. In other words, the time is little and the effort we have to put into it in order to survive is enormous. We essentially have three months, considering that, at the end of the year, the 26th Climate Change Conference will take place, where important decisions must be made. Otherwise it will be impossible for the countries to reduce pollution by 50% by 2030 which would retain climate change at 1.5 degrees.

Having read this, someone would wonder why we reached that point and why we only now realize that we must answer the call and take urgent measures in order to respond in the little time we have?

This is a matter quite old and has raised fierce discussions among the scientific and political community since 1970 and the data is even older. Since 1988 there is the Intergovernmental Panel on Climate Change which compiling reports and assessing the consequences of climate change. So, consequences have been assessed since 1998. On the other hand, having nations consent to tackling this problem is a difficult venture. The difficulty lies in the category of the commodity. We are talking about a global commodity we have to protect, and it is known that when things belonging to lots of people yet don't have explicit private property rights, managing them is a demanding task.

1.2Air Pollution-Greenhouse Effect-Consequences

Air pollution, ie., the channeling of compounds directly or indirectly in the atmosphere, in concentrations that may affect the structure, or the body chemistry is one of the biggest problems currently concerning humankind because of the negative effects on both to humans and the environment.

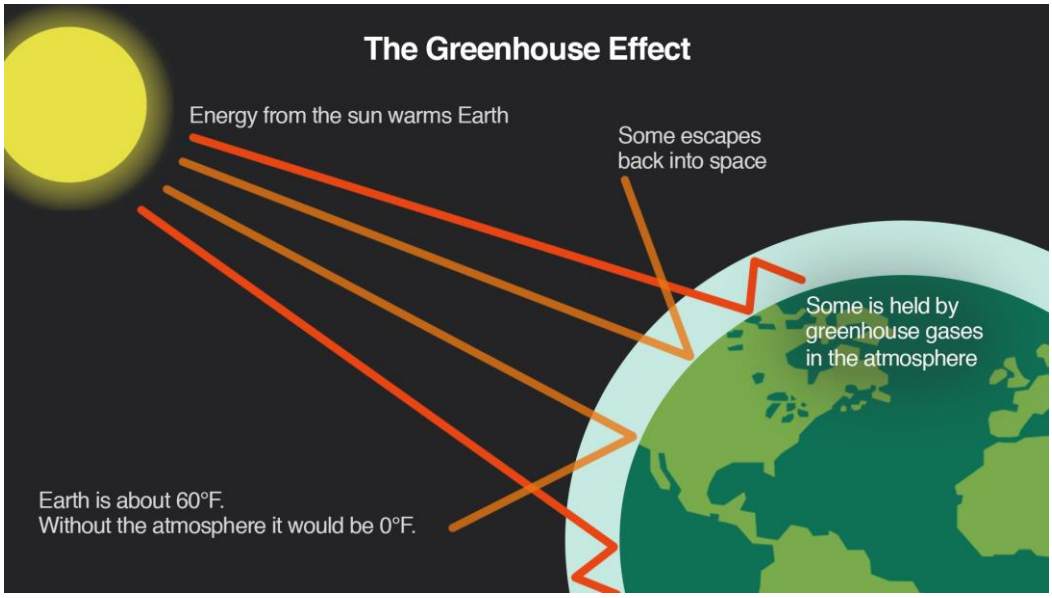
The pollution in urban centers is mainly due to contaminants emitted by cars and generally from transport, burners, heating, construction, and industries. The primary pollutants are nitrogen oxides (NOx), ozone (O3), sulfur dioxide (SO2).

The upper polluting compounds besides the obvious impact on health and quality of life are also causing significant environmental problems such as ozone hole, greenhouse effect and the problem of climate change.

One of the major environmental problems as mentioned above is the greenhouse effect and its impact on change climate's earth. Greenhouse gasses occur naturally and are critical for life on the earth. The gasses act like a blanket around Earth, trapping energy in the atmosphere and causing it to warm. Greenhouse effect is called the absorption of infrared radiation emitted by the sun from the atmosphere, causing the temperature of the atmosphere to grow. A part of the solar radiation passes unchanged in the atmosphere, reaches the soil surface and radiates as large infrared radiation length. A part of this absorbed by the atmosphere, the heating and retransmitted on the surface of the ground. However, the buildup of greenhouse gasses can change Earth's climate and result in dangerous effects to human health, welfare, and ecosystems. Human activities, primarily the burning of greater quantities of fossil fuels and the cutting of forests, have intensified the natural greenhouse effect, causing global warming.

The main greenhouse gases in the atmosphere is water vapors the (H2o), carbon dioxide (CO2), nitrous oxide (N2O), methane (CH4), ozone (O3), the Carbon monoxide (CO), nitrogen oxides (NOx) and hydrocarbons (CxHy) but also perfluorinated compound (PFCs) and sulfur hexafluoride (SF6). The most important "manmade" greenhouse gas is Carbon dioxide (CO2), followed by chlorofluorocarbons, methane and nitrous oxide. The atmospheric water vapors, which are expected to increase as the temperature at the earth's surface is increased, is still a critical greenhouse gas. Mainly water vapor and carbon dioxide cover the 85% of the greenhouse effect.

Image 1: The Greenhouse Effect



Bibliography:*The Greenhouse Effect. (2014, 4 16). Climate central.*

https://medialibrary.climatecentral.org/resources/the-greenhouse-effect

The major sources of greenhouse gasses are:

- electricity industries
- transport
- industrial facilities
- waste disposal
- agriculture factor

The above sources are shown in image 2, while image 3 provides the percentage contribution from each source. Note that the largest contribution is from electricity production industries.

Image 2: Important sources of greenhouse effect

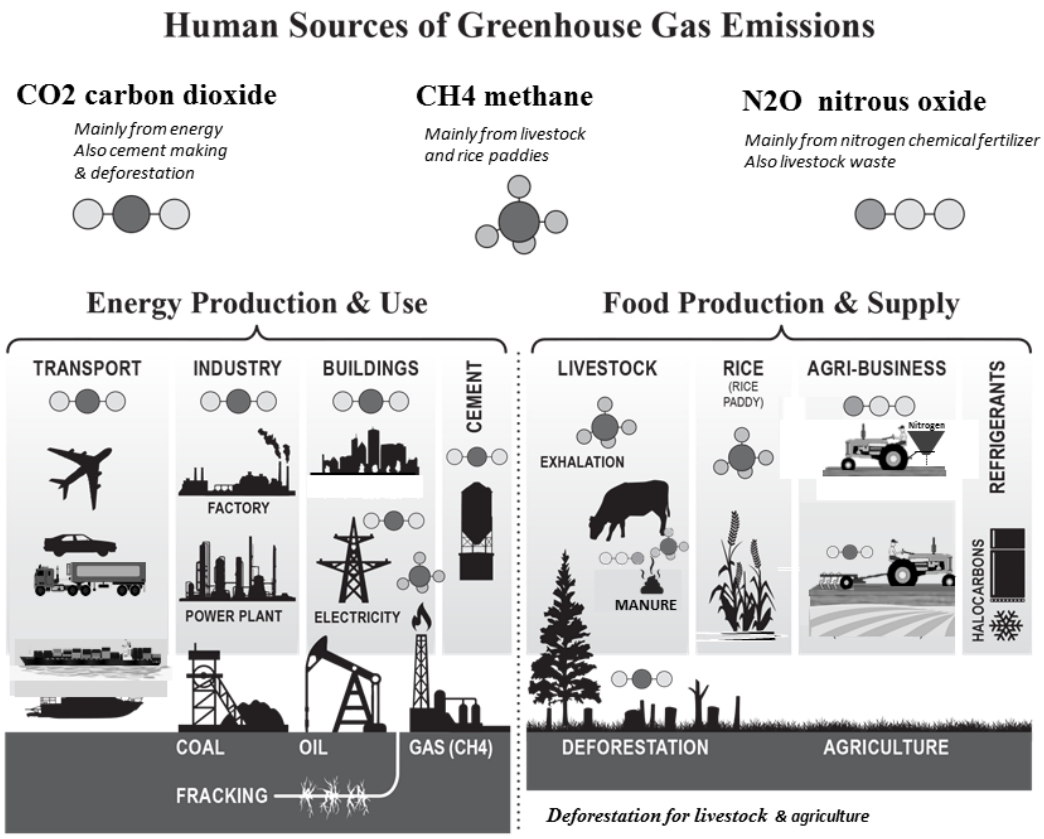


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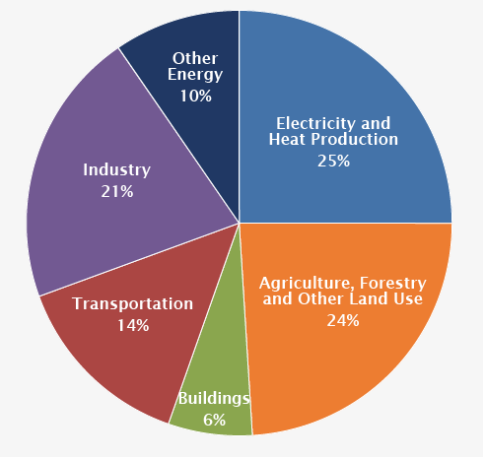
Image 3: percentage contribution from each source to greenhouse effect



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Global warming is causing climate patterns to change. Climate change refers to any significant change in the measures of climate lasting for an extended period.

As for the consequences, the most talked about effects of the phenomenon is the sea's rising level due to the melting of polar ice and desertification of areas in the temperate zone with the rainfall moving from equator to northward. The significant rise in the level of the sea is evident that will lead to the sinking of entire coastal areas.

Moreover, there are significant impacts on ecosystems. The characteristics of a zone, such as the topography, groundwater, and the condition of the ground in combination with climate, determine the types of vegetation that will flourish. Therefore, any climate change will cause corresponding changes in flora and fauna of the area.

Greenhouse effect, due to increased concentrations of CO2 and because of different climatic parameters, would affect agriculture through the photosynthesis. Moreover, the phenomenon has significant effects on human health due to greenhouse gasses, and they are even expected seasonal outbreaks of diseases, such as malaria, in the future warmer Western Europe. Also, the increase in the average global temperature is expected to make significant changes in energy demand.

Unfortunately, in previous years there were many examples.

The fires in the Siberian forests where an area like Belgium in size burned down. The smoke from the fires has affected air quality in much of Siberia, including cities as far west as Chelyabinsk and Yekaterinburg. Air travel was also disrupted.

Another example was the fires in Amazon in August 2019, where it is estimated that over 906 thousand hectares of forest within the Amazon biome has been lost. In addition to the impact on global climate, the fires created environmental concerns from the excess carbon dioxide and carbon monoxide within the fires' emissions, potential impacts on the biodiversity of the Amazon, and threats to indigenous tribes that live within the forest.

At the end the disaster in Australia. Huge acres of land were burned, people died, properties burnt to the ground, animals were burned, and this enormous catastrophe was unfolding for months. There was a situation, where very high temperatures together with very strong winds render the fire exhaustion impossible. The burnt was the size of the United Kingdom. The irony is that Australia, to date even, at the COP in Madrid in December 2019, didn't consent to the reduction of greenhouse gas emissions laid out by the Paris Agreement. To date, Australia is a country that refuses to sign the Paris Agreement. As Australia is the largest carbon exporter, unfortunately the government and all political activities are orchestrated by the carbon lobby.

Similar surveys on fires in Canada showed that:

1) Climate change is to blame by means of its doubling to quadrupling the changes of a fire breaking out at one place.
2) Second and most terrifying, it's septupling the range of the fire, i.e it's intensity and potential range.

These phenomena happened again in the past but due to climate change we see them more often and not every 50-100 years. Consequently, climate change means that these dangerous phenomena will be most frequent and most intense.

Is only climate change to blame for these phenomena?

On 15th of November 2017 were extreme floods in Madra, Greece. Within six hours, more than 200 mm of rain fell. In the nearby city of Elefsina the yearly precipitation is 370. In other words, in just six hours, the rain reached almost half of the yearly precipitation of Elefsina. As a result, it was an extremely highly localized phenomenon, which due to climate change, will be more frequent in the years to come. Climate change is not the only reason though. If there hadn't been random human interference with streams filled with garbage, if there had been anti-flood structures which were only designed after the incident, and proper maintenance of the existing infrastructure, it still would have occurred, but to a lesser extent.

All this, of course, will lead to chain problems which will concern all sectors of human activity since everything is connected with the environment, which is changing drastically.

1.3 Climate change and Economy

Apart from these negative effects, the increase of global warming is also causing adverse effects on the world economy. Specifically, the intergovernmental Panel on Climate Change (IPCC) estimates that an increase in temperature of around 2,5 ° C, will cost up to 1.5-2% of global GDP in the future. According to the German Institute for Economic Research (DIW), the increase in global temperature by just 1 ° C will cause global economic damage that will exceed 1,500 billion € by 2050. However, so far has not been entirely an assessment of the costs of climate change, mainly because it is tough to calculate the cost of the measures that are required to adapt.

Instead, there are estimates for emission abatement cost. According to Kyoto Protocol, as we shall see later, the reduction to 550 ppm requires reductions in global emissions of 15% to 50% by 2050, compared to 1990 levels. If under this scenario, the EU decides to reduce its emissions by 30% compared to 1990 levels, by 2025, it will cost from 0.5 to 1.3% of GDP. However, if the EU or industrialized countries act alone, the efforts will have limited impact and will not achieve the target of 2 ° C. Instead, the "flexible mechanisms "of the Kyoto, including the international emissions trading and the tools for encouraging cooperation between countries, will help to reduce the costs for the EU.

Many believe that environmental awareness is not beneficial for businesses. However, during the last decade, companies like DuPont, which has reduced its greenhouse gas emissions by 67% by 1990, has saved € 1.5 billion from the efficient use of energy and € 7-11 million annually through the use of renewable energy, proving just the opposite.

1.4 Ways to combat the problem and the necessary policy

These above consequences emphasize the importance of the problem and promote the urgent need to find solutions. Handling climate change requires answering three questions:

1. How we will reverse climate change. Which are the physical mechanisms that shape the Earth's climate and what are the human-made actions that disrupt the natural balance and create the causes of climate change?
2. What measures should be taken on technological, economic and above all, political and governmental level, to initially reduce the aggravation of the problem and eliminate it, in the end, if it is possible?

3. How will the economy adapt to the implementation of these measures, and in particular how will handle the cost of products (themes as competition) and investment (depreciation and profitability).

Community's efforts, deal with problems caused by climate change fall into different categories.

- Establishment and incorporation of targets relating to climate changes in the various community policies, particularly in energy policy and transport policy.
- Taking concrete measures to reduce greenhouse gas emissions through improvement of energy efficiency.
- Promotion of renewable energy sources and saving energy.
- Development of emission trade throughout Europe.
- Promotion of research on the climate change sector.
- Informing citizens about climate change.
- Investigation of energy subsidies and their compatibility with the problems of climate change.
- Nature and Biodiversity

Actions to manage the problem of climate change can be made at a government level, such as mandatory emission reduction or the provision of incentives. Also, at the private sector, such as the adjustment of production processes or the change of fuel used and at the end on an individual level, such as the choice of eco-friendly products or the avoidance of actions that are burning off natural resources without reason. Certainly, the type and efficiency of activities vary from the type and the consistency of application.

1.5 Climate change in context

The start for finding solutions to climate change was made at the international level, in 1979, with the first World Climate Conference (WCC). In 1988 the Intergovernmental Panel on Climate Change was set up (IPCC). Two years later, in 1990, IPCC's first assessment report was released. IPCC and the second World Climate Conference were calling for a global treaty on climate change, and United Nations General Assembly negotiations on a framework convention had begun. In 1991 the first meeting of the Intergovernmental Negotiating Committee (INC) took place. At 1992, the INC adopts United Nations Framework Convention on Climate Change (UNFCCC), at the Earth Summit in Rio, the UNFCCC is opened for signature along with its sister Rio Conventions, United Nations Convention On Biological Diversity (UNCBD) and United Nations Convention to Combat Desertification (UNCCD). Nearly all countries joined the international treaty UNFCCC, a framework for international collaboration to combat climate change. The means to success was by limiting average global temperature increases. The framework pledges to stabilize greenhouse-gas concentrations "at a level that would prevent dangerous anthropogenic interference with the climate system."

Subsequently, the Convention encourages industrialized countries to stabilize greenhouse gas emissions (GHGs).

Later in 1994, the UNFCCC entered into force, and in 1995 the first Conference of the Parties (COP 1) took place in Berlin, where countries started negotiations to enhance the global response to climate change. Two years later, (11 December 1997) adopted the Kyoto Protocol (KP) at Kyoto of Japan. The Protocol provides a procedure under which future actions can be intensified to encounter climate change through reduction, each country individually or in cooperation with other nations, emissions of the six greenhouse gasses, initially for the period 2008-2012 in percentage more than 5% from 1990 emission levels.

- 2001 - IPCC releases the third Assessment Report. Bonn Agreements adopted, based on the Buenos Aires Plan of Action of 1998. COP 7 adopts Marrakesh Accords, which was a set of agreements detailing the rules for the implementation of Kyoto Protocol and setting up new funding and planning instruments for adaptation and also establishing a technology transfer framework.

- 2005 - Kyoto Protocol entries into force. The first Meeting of the Parties to the Kyoto Protocol (MOP 1) takes place in Montreal. Following Kyoto Protocol requirements, Parties launched negotiations on the next phase of the KP under the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP). Also, what was to become the Nairobi Work Program on Adaptation (it would receive its name in 2006, one year later) is accepted and agreed on.

- 2007 -IPCC releases its fourth Assessment Report. Climate science entered into popular consciousness. At COP 13, Parties agreed on the Bali Road Map. The Bali Road Map includes the Bali Action Plan (BAP) that was adopted by Decision 1/CP.13 of the COP-13. It also includes the Ad Hoc Working Group on Further Commitments for Annex I Parties under the Kyoto Protocol (AWG-KP) negotiations and their 2009 deadline, the launch of the Adaptation Fund, the scope and content of the Article 9 review of the Kyoto Protocol, as well as decisions on technology transfer and on reducing emissions from deforestation.

- 2009- Copenhagen Accord drafted at COP 15 in Copenhagen. This was taken note of by the COP. Countries later submitted emissions reductions pledges or mitigation action pledges, all non-binding.

- 2010 - Cancun Agreements drafted and largely accepted by the COP, at COP 16. The agreements reached on December 11 in Cancun, Mexico, at the 2010 United Nations Climate Change Conference represent key steps forward in capturing plans to reduce greenhouse gas emissions and to help developing nations protect themselves from climate impacts and build their sustainable futures.

- 2011- The Durban Platform for Enhanced Action drafted and accepted by the COP, at COP17.

- 2012 - The United Nations Climate Change Conference in Doha, Qatar, took place from 26 November to 8 December 2012. It included the eighteenth session of the Conference of the Parties (COP 18) to the United Nations Framework Convention on Climate Change (UNFCCC) and the eighth session of the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (CMP 8). Negotiations in Doha focused on ensuring the implementation of agreements reached in previous conferences. The package of "Doha Climate Gateway" decisions adopted on the evening of Saturday, 8 December, included amendments to the Kyoto Protocol to establish its second commitment period

- 2013 - Key decisions taken at COP 19/CMP 9 include decisions on further advancing the Durban Platform, the Green Climate Fund and Long-Term Finance, the Warsaw Framework for REDD Plus and the Warsaw International Mechanism for Loss and Damage. Under the Durban Platform, Parties agreed to submit "intended nationally determined contributions," known as INDCs.

- 2014 - Lima Call for Action' was from COP 20. Nations concluded by elaborating the elements of the new agreement, scheduled to be agreed in Paris in late 2015, while also agreeing on the ground rules on how all countries can submit contributions to the new agreement during the first quarter of next year.

- In September 2015, 193 states signed in New York the Sustainable Development Goals, the UN 2030 agenda. Seventeen clear goals, where half of them are directed linked to the climate and the environment. The rest support efforts for sustainable development including the climate and the environment.

- 2016- A few months later, there is the Paris Agreement. The agreement is about climate change, an effort to prevent temperature from rising at least by two degrees. Paris Agreement attempts to accelerate and enhance the actions and investment needed for a sustainable low carbon future. Countries will aim to achieve carbon neutrality in the second half of the century. The agreement aims at holding global warming to well below 2 degrees Celsius above pre-industrial levels and to "pursue efforts" to limit it to 1.5 degrees Celsius. The Agreement also aims to strengthen the ability of countries to deal with the impacts of climate change. In order to accomplish that, countries have submitted Intended Nationally Determined Contributions (INDCs) outlining their post-2020 climate action. To reach these ambitious goals, the agreement acknowledges that $100 billion (in loans and donations) will need to be raised each year from 2020 to finance projects that enable countries to adapt to the impacts of climate change, (rise in sea level, droughts) or reduce greenhouse gas emissions. The agreement establishes an obligation for industrialized countries to fund climate finance for developing countries while developing countries are invited to contribute on a voluntary basis. The Agreement will also enhance transparency of action and support through a more robust transparency framework.

- In 2018, the report of IPCC is issued, of the Intergovernmental Panel on Climate Change that is, stating that two degrees are too much. It should be 1.5. This is the highest rise we can stand and continue living safely on the planet with.

- In September 2019, in New York, the UN Sustainable Development Solution network (which is the network for sustainable solutions of the United Nations) announced the six paths leading to sustainability. Every country should develop six transformation pathways leading to sustainability. They include decarbonization, sustainable cities, ethical and sustainable exploitation of the land, of the sea and of water sources, digital evolution for sustainable development, as well as education, equality, health and prosperity. Each country has to plan the method leading to the transition. Then they will be able to check whether the transitions methods they set up follow the correct course in order to ensure that by 2050 we won't be using carbon any longer. Both the society and the economy should stop depending on carbon. The meaning of the 1.5 degrees Celsius limitation means non-carbon societies by 2050.

1.6 The legal framework of Green deal

The implementation of the Europe Green Agreement requires careful evaluation, analysis and planning of current and future legislation. At the same time, it is important to leave room for new, innovative ideas that will lead faster and more efficiently to a sustainable future. An approach based on the principle of innovation can be a useful tool in this regard.

As it was mentioned above, the start for finding solutions to climate change was made at international level in 1979 and in 1992 signed the United Nations Framework Convention on Climate Change. Since then, it began to establish the relevant legislation in order to limit or prevent the negative consequences. The relevant legislation for climate change covers the following issues:

- Monitoring mechanism of greenhouse gas emissions with Directive No. 280/2004 / EC of the European Parliament and of the Council of 11 February 2004, in order to assess the reduction of emissions and meet obligations under United Nations Framework Convention on Climate Change and the Kyoto Protocol
- Emission trading system. Trading emissions that contribute to the greenhouse effect under Directive 2003/87 / EC of the European Parliament and of the Council of October 13, 2003, and amending Directive 96/61 / EC.
- Implementation of the European Climate Change Program (ECCP), which aims to combat climate change through measures in the fields of energy, industry, and transportation. For the implementation of the first phase of the European Program Climate change, the related notice published by the Commission on 23 October 2001 (final COM (2001) 580).

- Kyoto Protocol on Climate Change which was ratified by Decision 2002/358 / EC of 25 April 2002 and has as aim to reduce emissions that cause the greenhouse effect and are responsible for the rise in global temperatures.
- Post-Kyoto Community strategy, which seeks to develop a Community Strategy for targets set under the Kyoto Protocol and the Agenda of Buenos Aires.

1.7 Directive 2003/87 / EC Emissions Trading

The emissions trading (Emissions Trading / ET) (actually trading of emission rights) as mentioned above is one of the necessary tools provided by the Kyoto Protocol, in order to achieve its goals. The implementation of the Emissions Trading Scheme (ETS) in international scale operates theoretically by 01/01/2005 and initially covered carbon dioxide emissions only from large stationary sources.

The need for policy planning, regarding the emission trading, led to a Common Position which was accepted by the Commission on March 18, 2003 (15792/1/02 REV 1) and finally agreed to by the European Parliament on 13 October 2003 (Directive 2003/87 / EP).

In Greece, responsible for the formation of the National Allocation Emissions Plan is the Ministry of Environment and Energy. In the projected planned project activities are included: actions of technical consultant for the efficient implementation of the Directive, the development of the requirements for the National Registry of Transaction Log, the planning of monitoring - logging – emissions system and finally the planning of incentive /disincentives system for the effective implementation of Directive.

The Directive provides for the operation of a Community trading GHG emissions system, in order to fulfill better the commitments of the European Community's and Member – States for reducing greenhouse gas emissions. At the same time, it seeks to limit, as far as possible, the negative impact on economic growth and employment.

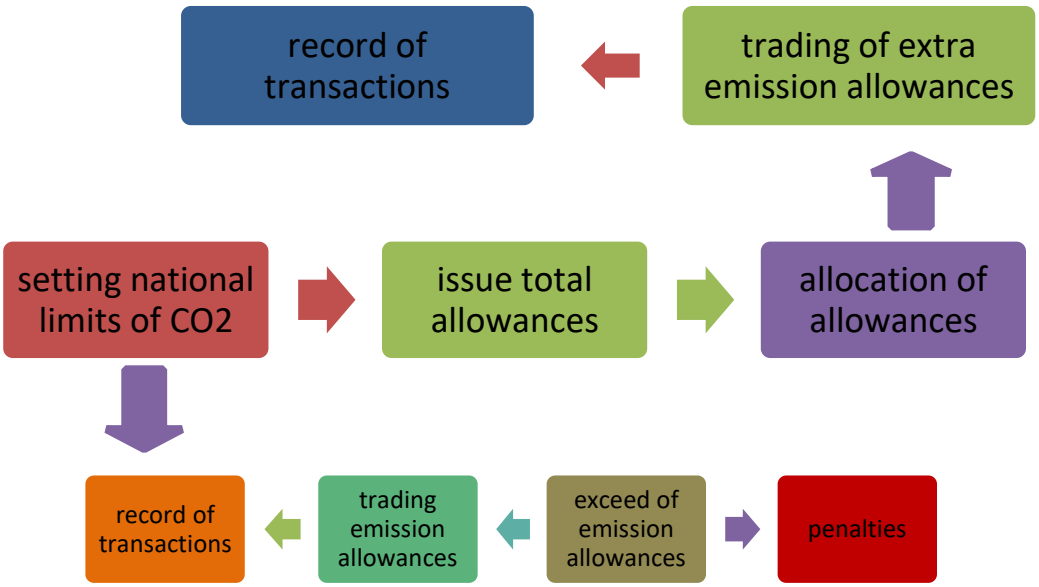
More specifically, the objectives of the Directive are:

- Accelerating the implementation of the Emissions Trading mechanism.
- Gaining experience from the operation of the mechanism before the start implementation of the Kyoto Protocol.
- Utilization of the mechanism for reducing GHG emissions in member states of European Union with emphasis on large stationary sources of CO2.

Each country is obliged to establish an Authority which is responsible for implementing the Directive at a national level and is responsible for the issuance of licenses which is done in two stages, the first started on 1 January 2005, while the second began on 1 January 2008. Subsequently, the allocation of licenses will take place every five years. The licenses will be distributed free in businesses according to the "National Allocation Plans».

Directive covers about 12000 installations (energy sector, production, and processing of ferrous metals, paper plant), which owns half of the carbon dioxide emissions in Europe.

Image 4: The sequence for emission trading system



Each Member State is obliged to determine national limit values for CO2 emissions and then to allocate them between particular categories of businesses, issuing a total number of pollution allowances (rights). If the emission allowances are exceeded, the business has polluted more than it was supposed to (one allowance equals one ton of CO2), the company is obliged to pay a fine of 100 euro (40 during the first three years- phase 1) for each excess emissions tone.

1.8 National allocation plan

Pursuant to Article 9 of the Directive, each Member State periodically has to develop a national allocation plan. For the convenience of Member States regarding the preparation of the National Allocation Plans, Article 9 mandates the Commission to develop guidance on the implementation of the criteria listed in Annex and to develop guidance to describe the circumstances under which the same date demonstrates force majeure.

The Directive is a fundamental element of the Community's climate change policy, and its objective is to promote reductions of greenhouse gas emissions in a cost-effective and economically efficient manner. It is, therefore, important to ensure that the emissions trading

scheme has a positive environmental outcome. The national allocation plans are the means to achieve this goal.

The National Allocation Plan was developed based on the criteria of Annex III of the Directive and the guidance of European Commission for their implementation. The criteria are listed in Table 1 that follows. At the same time, the plan includes all the necessary baseline information to substantiate in this way any regulations provided in this.

Annex III to Directive 2003/87/EC contains 11 criteria relating to the national allocation plans.

Table 1: Categorization of the criteria

	Mandatory M/Optional O	Total level	Activity /Sector	Installation Level
Kyoto commitments	(M)/(O)	+		
Assessments of emissions development	(M)	+		
Potential to reduce emissions	(M)/(O)	+	+	
Consistency with other legislation	(M)/(O)	+	+	
Non-discrimination between companies or sectors	(M)	+		+
New entrants	(O)			+
Early action	(O)			+
Clean technology	(O)			+
Involvement of the public	(M)			
List of installations	(M)			+
Competition from outside the Union	(O)		+	

1.9 Transport and storage allowances

The transfer of allowances from the 2008-2012 period until the next application period 2013-2018 is mandatory. As so, a company has the right to use the allowances that were issued this year, to cover its emissions next year. Also, it can store the allowances and auction them next year.

The advantages of the transfer are multiple. Companies have the opportunity to refrain and do not react carelessly only to move under the standards set by the European Union but to act calmly and with the appropriate planning by investing in the areas that will lead to a substantial emission reduction. One company is able not only to buy but also to transfer allowances from other uses to make the best possible investment.

However, thereby the application of those agreed in the Kyoto Protocol is limiting. Also, the constant borrowing and transfer of allowances can lead to an extended period of dangerous pollution.

With the continuous transfer of the allowances, businesses can gain time to plan better their moves. On the other hand, it is likely some firms to take advantage of this opportunity by presenting elements about their course artificially, and so their future targets would be more flexible than they should be. As a result of all the above would be, the failure to determine the response of the measures on targets for reducing emissions but also the delay of their achievement.

1.10 The Union Registry

The scope of the Union registry is to ensure accurate accounting of EU allowances issued under the EU ETS and international credits. The Union registry is an online database which shows who owns what emission allowances and performs transactions between accounts. Actors (natural or legal persons) wishing to participate in the EU ETS, need to open an account in the Union Registry. Different types of accounts can be opened within the registry depending on the nature of the account holder or his activities.

- (Aircraft) Operator Holding Account are for actors with compliance obligations under the EU ETS, used to hold and transfer units, and record verified emissions and surrendered allowances
- Person holding accounts are for any individuals or companies to hold and transfer units
- Trading accounts are also for any individuals or corporations to hold and transfer units and are subject to more flexible transfer rules than person holding accounts
- Verifier accounts are for verifiers to check reported emissions of operators with the system. They do not hold allowances or KP units.
- Administrative accounts, exclusively for the National or Central Administrators.

Operators and aircraft operators in the EU ETS need to open an account to receive free allowances, obtain allowances bought from auctions or exchanges and surrender allowances. For opening an account, the account holder has to provide specific supporting evidence on the account holder and representatives (natural persons) that are authorized to use the account. These documents are checked by the relevant national administrator receiving the account opening application before the account can be activated.

The Union Registry can be accessed online in a similar manner to online banking systems. However, it is important to note that the Union registry keeps track of the allowances and Kyoto units only. Financial transactions take place outside the registry, and only subsequent movements of allowances or Kyoto units between accounts (also called deliveries) are recorded in the registry. The Union registry records:

- National implementation measures (a list of installations covered by the ETS Directive in each EU country and any free allocation to each of those installations in the period 2013-2020).

- Accounts of member states, companies or individuals to which those allowances have been allocated. The main types of EU ETS transactions are the creation of allowances, free allocation, transfers, surrendering and deletion.
- All the transactions performed by account holders, as well as the transfer of any CDM or JI credits in or out of the EU ETS
- Annual verified CO2 emissions from all EU ETS compliance installations and aviation operators.
- Annual reconciliation of allowances and verified greenhouse gas emissions, as well as compliance status, where each company must have surrendered enough allowances to cover all its verified emissions.

1.11 Kyoto Protocol

1.11.1. Historical review

Over the last years, efforts are made for the effective protection of the environment. These efforts aim to establish a legal framework for environmental protection at both European and international level. For the formation of this legal framework, world conferences are organized under the auspices of an international organization or some group states. The first global conference began in 1972 with the conference in Stockholm, and after that followed many others.

The Kyoto Protocol arose out of the United Nations Framework Convention on Climate (UNFCCC), which was signed at the Rio Conference in June in 1992, by almost all states. Kyoto Protocol aims to the "stabilization of concentrations of greenhouse gasses in the atmosphere at a level that would prevent dangerous anthropogenic (human-induced) interference with the climate system." Also "such a level should be achieved within a time-frame sufficient to allow the ecosystem to adjust naturally to climate change, to ensure that food production is not threatened and to enable economic development to proceed in a sustainable manner ".

Greece ratified that convention, making this law of the State in April 1994. In the context of this Convention, at the third Conference of Parties (Kyoto, December 1997) an important implementation has been set to control emissions, known as Protocol Kyoto. At this point, only the general context and the basic principles of the protocol have been given while the next Conference (Buenos Aires 1998) gave a clear picture of the Protocol and at the same time established a two-year Action Plan to intensify preparations for the implementation of the Protocol. Despite the efforts for common acceptance of the convention in the 5th conference that followed, there were significant differences which led to the failure of the negotiations.

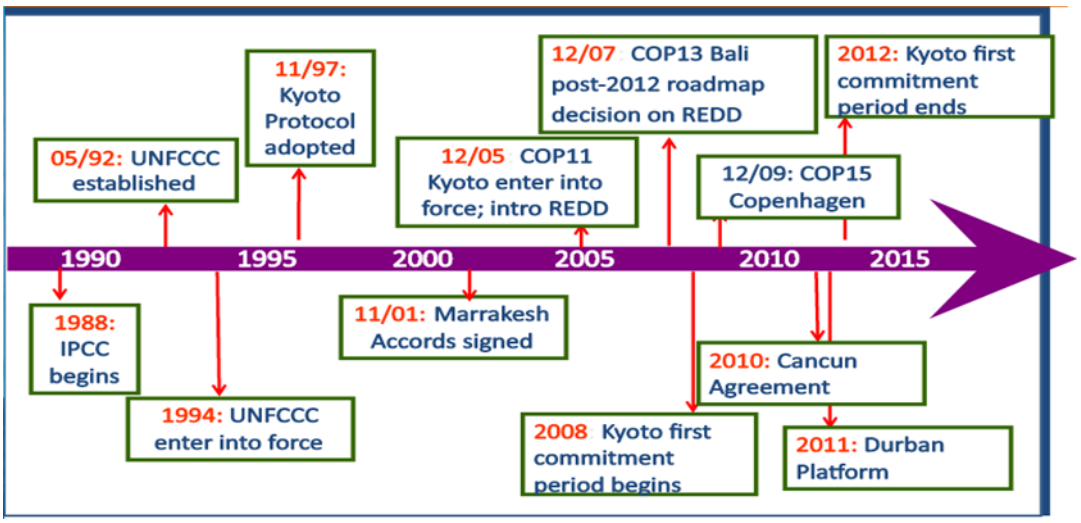
The following year at the 6th COP, the negative climate that was overruled finally was overturned, and during the 7th Conference in Marrakech, important decisions and agreements

regarding the terms of the Protocol and implementation of the United Nations Convention on Climate Change have been made.

Some parts of the protocol finalized at the Agreement of Marrakech while at the same time it was being prepared for full acceptance and its final implementation. During the 7th Conference, pressures have been made for the acceptance of the Protocol from the US, with no result. Important decisions were taken for the flexible mechanisms, development to address climate change, promotion of innovative technologies and the strengthening of international cooperation on the issues of biodiversity and desertification.

At the same year (2001), IPCC, issued its third assessment report, saying that the recent technological progress was sufficient and had led to the reduction of greenhouse gasses emissions with lower costs.

Image 5: climate policy timeline



1.12 Highlights of Kyoto Protocol

This Protocol is an international and legally binding agreement to reduce GHG emissions worldwide. The Kyoto Protocol supplements and strengthens the treaty of Rio. It was founded and based on the same principles which underlying the treaty while it has a common goal. This goal is to stabilize greenhouse gas concentrations at such prices as not to cause climate change. Kyoto Protocol is built on the principles of the Convention; therefore it recognizes that principally responsible for the current high levels of GHG emissions in the atmosphere, are the developed countries because of the result of more than 150 years of industrial activity.

The Kyoto Protocol commits 37 industrialized countries and the European community in its first commitment period, to stabilize greenhouse gas emissions. For the first time, with Kyoto protocol was defined legally binding targets for reducing emissions of greenhouse gasses. Six greenhouse gas covered: Carbon dioxide (CO2) Methane (CH4) Nitrous oxide (N2O) Hydrofluorocarbons (HFCs) Perfluorocarbons (PFCs) and Sulphur hexafluoride (SF6)

On 16 February 2005, KP entered into force. The detailed rules for the implementation of the Protocol were adopted at COP 7 in Marrakesh, Morocco, in 2001.Kyoto Protocol's central principle is: "common but differentiated responsibility." There are currently 192 Parties to the Protocol.

The first commitment period was between 2008 - 2012. The emission reduction target was up to an average 5% compared to1990 levels. The second commitment period began on 1 January 2013 and will end in 2020, and it was launched in Doha. Qatar on 8 December 2012 and Parties committed to reducing GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020.

<u>The main points of the Protocol can be summarized as follows:</u>

The developed countries commit to reducing their overall emissions by at least 5%. This target refers to six gasses (referred earlier)

• The goal of every state should be achieved in 2008-2012.

• Joint implementation. Member States may declare joint fulfillment of their obligations through an agreement that will sign where it would be mentioned the duty of every state as for the level of emissions.

• The ability to fulfill part of its obligations through three flexible mechanisms. The Kyoto Protocol provides the opportunity to achieve the fulfillment of obligations with the help of three mechanisms: joint implementation mechanism "clean" development and emissions trading. The general condition is the fulfillment of obligations through such mechanisms to be supplemental to national actions for achieving the goal.

• Adopt policies and measures. The Protocol commits States Parties to implement or adopt policies and measures to achieve the targets of the Protocol, in agreement with the national conditions of each country. It also includes an indicative list of specific actions that can be implemented by the States Parties.

• Strict compliance. The Protocol provides the establishment of a strict compliance framework

• There are no quantitative targets for developing countries.

In the framework of the protocol, there are 186 countries which are parties and they are divided into two main groups:

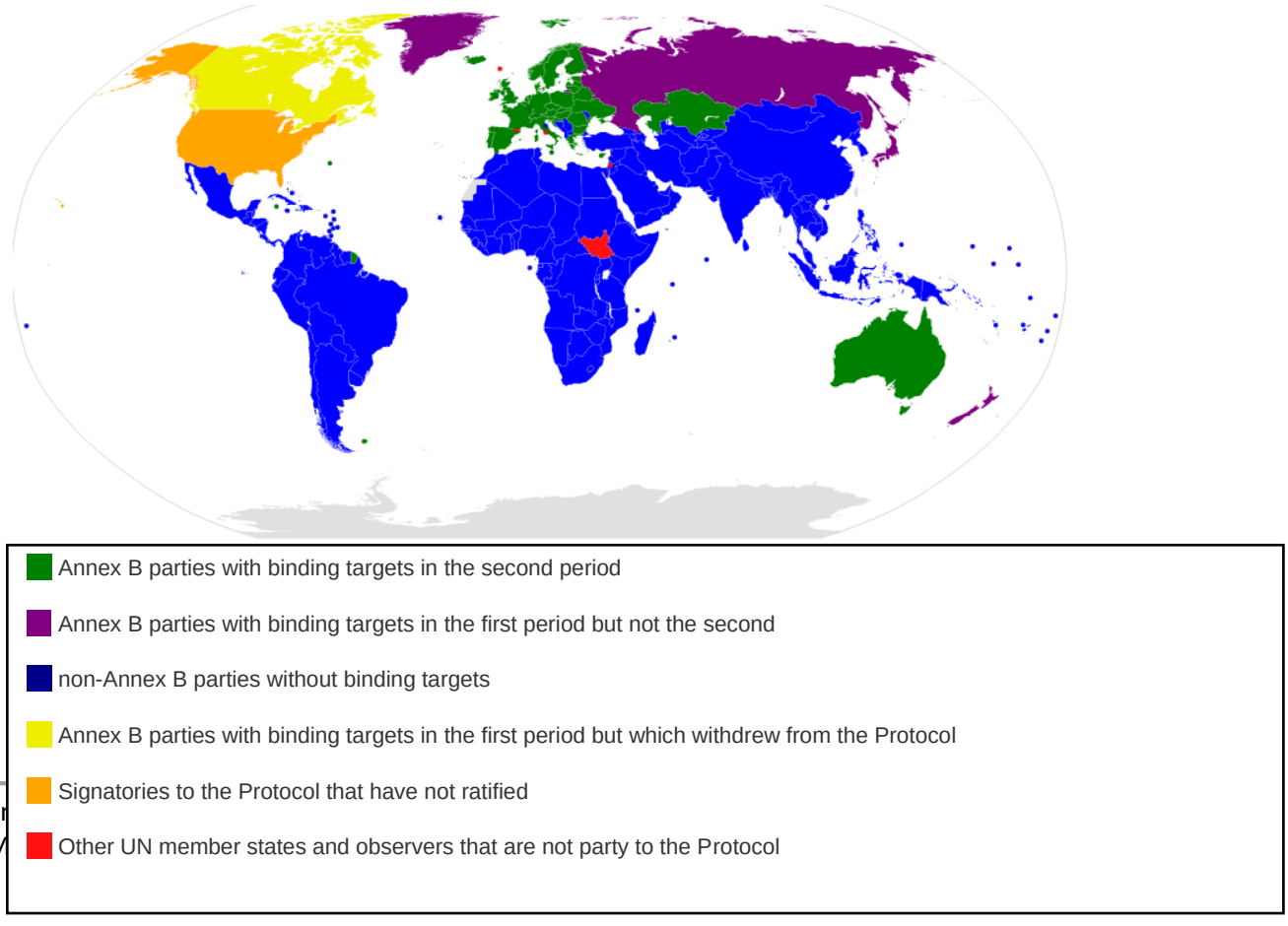
- Annex I Parties: there are 40 industrial countries in total. In these, they included 24 relatively wealthy industrialized countries that were members of the Organisation for

Economic Co-operation and Development - OECD in 1992, the 15 EU Member States and 11 countries with economies in transition phase to a market economy, including Russia, the Baltic countries and some countries of Central and Eastern Europe.

- Parts except Annex I: it is about the remaining 146 developing - mainly - countries which are not included in Annex I [this includes countries that are vulnerable either because of the negative effects of climate change (such as the countries that would face significant problems because of the rising sea levels and desertification and drought), or because of potential impacts on their economy, due to measures against climate change from third countries (such as countries whose income is mainly based on the production and trade of mineral fuels)]. The Convention gives special attention to those 48 countries which are characterized by the United Nations as least developed due to their limited ability to respond to climate change and adapt to the negative effects. Specifically, it is provided that some means should be taken (for example, funding and technological know-how transfer) to meet their needs.

Apart from these two categories, there is a group of parts of Annex II. This group is a subset of Annex I Parties group. It consists of those Annex I Parties that are members of the OECD, but not the parties with economies in transition. The parts of Annex II should provide financial resources to developing countries to help them achieve their goals of reducing their emissions and adapt to the negative impacts of climate change. Additionally, parts of Annex II should provide the necessary expertise for the development of environmentally friendly technologies both in countries with economies in transition and developing countries.

Image 6: A map of the parties to the Kyoto Protocol



Annexes A and B of the Kyoto Protocol

Annexes A and B of the Kyoto Protocol include several critical components relating to the operation of the mechanisms provided from this, to combat climate change.

Specifically, Annex A includes:

• gasses that contribute to global warming and participate in the Kyoto mechanisms and

• sectors and sources that are responsible for these gasses and who participate in the Kyoto mechanisms

Annex B of the Kyoto Protocol includes the targets of the parties.

1.12.1. Flexible mechanisms of the Kyoto Protocol and principles

The Kyoto Protocol is a "road map," which includes the necessary steps for a long-term battle with climate change caused by the increase in anthropogenic greenhouse gas emissions. According to this, the states that have signed the Kyoto Protocol, commit to reducing greenhouse gas emissions to the first commitment period (2008-2012) at a particular target concerning the emissions in 1990 (or 1995 for certain gasses). The aim of the countries is to meet their goals through national measures. In any case, the Protocol has three market-based mechanisms, which Parties can use to achieve their emission targets in a cost-effective way, so as not to overload the global economy.

The Kyoto Protocol includes three flexible mechanisms:

- ✔ Emissions Trading,
- ✔ Joint Implementation
- ✔ Clean development mechanism.

The first mechanism provides the trading of emissions allowances between the interested parties (such as states and bound plants) based on the theory of property rights, while the other two are based on project programs (in countries of Annex I, while the second and the third in non-Annex I countries).

- Emissions trading: International Emissions Trading is a system where parties that have exceeded their emission reduction commitments under the Kyoto Protocol may sell excess “assigned amount units” (AAUs). Other parties may meet their emissions reductions by purchasing these AAUs or offset credits from developing countries. As provided by Article 17, states that have made commitments to the Protocol (Annex B) may participate in emissions trading systems to fulfill their goal, but only complementary to their national actions. It provides the allocation of licenses to the

polluters, for the emission of greenhouse gasses, which can then be traded between them.

- Joint implementation: Article 6 enables implementation of joint programs and activities between Annex I countries of the Convention. The country that finances the project benefits from the emission reduction that will occur from the implementation of the program in the other contracting country. It is critical that the project induces further emission reductions in the country of application. Most developed countries are under pressure to achieve their commitment and would have problems accepting JI projects in their country, as it essentially means transferring emission reduction credits to other countries. It is, in reality, only Economies in transition (former Soviet Union block countries) that, due to their industrial and economic collapse in mid-1990: ie., have already achieved their emission targets, and therefore can afford to allow other countries to use their emission reduction opportunities through JI.

- Clean development mechanism: Article 12 provides the opportunity for implementing programs from developed countries (Annex I to the Convention) in developing countries (non-Annex I Parties). Clean development mechanism provides incentives so that developed countries implement an emission reduction project in developing countries. If we assume voluntary participation, developed countries benefit from the emissions reductions that result, to meet part of their commitments, while developing countries benefit from the implementation of programs (financing, technology). In other words, a developed country, instead of shortening its emissions can help in reducing emissions in a developing country, where the reduction will be easier and less expensive. The achieved emission reduction contributes to their domestic emission reduction commitments. It is a basic prerequisite for the certification of additional emission reduction and the existence of benefits for addressing climate change in the developing country.

- In particular, the mechanism of "clean" development (CDM), as it covers projects in countries which have not taken specific commitments, aims to the further promotion of the sustainable development in the developing countries through projects financed by developed countries and lead to emission reduction. Moreover, through levies on these projects, a special fund is fed to help developing countries.

- In order the mechanisms to fulfill the above purposes, there is a need to respect the principle of "supplementarity ." The Protocol defines that the use of both mechanisms - emissions trading and joint implementation should be complementary to the national actions. For the mechanism of "clean" development, defines that it can be used to secure part of their obligations, with quantitative targets. These terms are included in the Protocol to ensure that the main means to meet the commitments that were made in Kyoto will be the national actions (implementation of policies and measures). The

definition of «supplementary» or "part of its obligations" is an issue that concerns the international negotiations.

- The JI and CDM mechanisms are based on projects that reduce emissions and create carbon credits (ERUs and CERs respectively) that can be channeled into the global carbon market. The implementation of JI and CDM projects results in the transfer of emission reductions units from one country to another, but the total emissions permitted in the countries remains the same.

In order the mechanisms to fulfill the above purposes, there is a need to respect the principle of "supplementarity ." The Protocol defines that the use of both mechanisms - emissions trading and joint implementation should be complementary to the national actions. For the mechanism of "clean" development, defines that it can be used to secure part of their obligations, with quantitative targets. These terms are included in the Protocol to ensure that the main means to meet the commitments that were made in Kyoto will be the national actions (implementation of policies and measures). The definition of «supplementary» or "part of its obligations" is an issue that concerns the international negotiations.

1.13 Targets and expected benefits from flexible mechanisms

The purpose of these mechanisms is to allow industrialized countries the ability to meet their targets through emissions trading, but also by gaining credits in return for fulfilling projects (abroad) which aim to reduce emissions.

The flexible mechanisms are based on the assumption that the emissions of the greenhouse are a global problem and that the place where their limitation is accomplished is of secondary importance. In this way, reductions can be made where the cost is lowest, at least in the first phase of combating climate change. At the same time, detailed rules and supervisory structures have been established to ensure that there will not be any abuses of these mechanisms. This system will provide motivation to companies to reduce emissions where it costs less, ensuring that reductions cost the lowest possible for the economy and also the promotion of innovation.

The role of the flexible mechanisms is to enable and attract global market, businesses and enhance the implementation of policies to combat the climate change phenomenon by reducing emissions of greenhouse gasses. The problem of climate change is a global phenomenon because it results from the overall level of greenhouse gasses concentrations in the atmosphere and not the relative concentrations per geographic region. As so, achieving emission reduction in one area benefits the entire planet. Through this way, the environmental benefits (emission limitation) maximize concerning the spending capital, while the investor country fulfills its commitments to the Kyoto Protocol.

The implementation of the flexible mechanisms gives the opportunity both at a national and at a private level to take environmental measures or to make investments for the benefit of the environment while the economic benefit maximizes.

The JI and CDM will also transfer environmentally friendly technology to countries with economies in transition (JI), and in developing countries (CDM), which will help them to follow sustainable development.

CHAPTER 2

2.1 Emission Markets

2.1.1. Introduction

Emissions trading, as already mentioned, is one of the three "flexible mechanisms" of the Kyoto Protocol. The aim of trading is to reduce greenhouse emissions and at the same time allowing market forces to continuously distribute the emissions in a way as to create the highest possible financial values.

Emissions trading was developed in the 70s and 80s and was introduced in the US in 1990 to combat acid rain. There are many programs based on cap and trade system such as Sulfur Allowance Trading in the United States which aim was to reduce SO_2 emissions from a power plant. Another program is the Ozone Transport Commission which aim was to reduce NOX emissions from industrial installations in ten states in Northeast of the United States, and also the RECLAIM program which aim was to reduce NOX and SO2 emissions from various industrial facilities in South California. In Europe, the largest greenhouse gasses trading program is the European Trading Scheme which aims to reduce greenhouse gas industrial emissions and trades primarily European Union Allowances (EUAs). In Great Britain, there is also one program for the greenhouse gasses, there is also an emission trading program for SO2 in Slovakia and in Danish one for CO2.

In general, with the emission trading, an industry other than the emissions rights which already has, can buy additional emission rights from another industry which has them as "excess," as a result the first emits more, but cumulatively the environment does not burden further.

There are international and national systems that allow sale or transfer of greenhouse gas emission allowances, between industries or countries participating in such a system.

2.2 Fundamentals – development - and types of trades

The stock market is an organized market, recognized by the State, in which financial transactions occur using a wide range of stock products. The law of supply and demand is applicable, basis of which prices of products are affected. The stock market is now also doing

the trading of carbon emissions. In Europe, inaugurated on 1 January 2005 and at the first phase 2005-2007 sold at least 5 billion tons of carbon dioxide with one unit equaling one ton of carbon dioxide. The first recorded transaction was between SHELL INTERNATIONAL TRADING & SHIPPING COMPANY and BHP BILITON on 5 January 2005.

The market of greenhouse gasses has all the features of most markets. Like any other market consists of sellers and buyers, while the first submit bids for reductions or options on reductions (purchase agreements at a fixed price with a deadline), while the second submit offers for reductions or options on reductions. Buyers make investments in existing or proposed projects and businesses that are expected to reduce emissions, with the expectation that these reductions will someday be chosen for credits by appropriate international or national authorities.

Here it is important to mention that permits are different from allowances:

- Permits: refer to specific companies which have assumed specific commitments. Licenses cannot be transferred and oblige the company to surrender a number of licenses equal to the emissions of greenhouse, at the end of each year
- Allowances: issued only by the Member States and are tradable only in the European Union. All transfers are registering in the National Trade Register (national registry) each right gives opportunity emission = 1tn CO2eq.

Table 2 Permits and Allowances

Permits	**Allowances**
Refer to specific facilities at a particular geographic location.	Issued by the member states.
They cannot be transferred	Each allowance enables emitting 1 ton CO2eq.
Determine specific obligations for monitoring and reporting for each installation	Tradable throughout the European Union
Require the installation, at the end of each calendar year to deliver a number of allowances that equals the GHG emissions, for the given year.	The transfers, deliveries, cancellations etc. are recorded in electronically form to the National Registry

Trading can be done through three ways. The first is directly between buyers and sellers, commonly referred to as “Over-the-Counter” (OTC), the second is through organized exchanges, and the third is via auctions. In the EU ETS, there are different types of trades. For instance, there are transactions for immediate delivery of allowances, so-called "spot" trading and derivative trading such as futures, forwards or options. Spot trading represents a small percentage of transactions contrary to the derivative trading which hold the lion’s share of transactions.

Acts OTC (Over the Counter)

These acts are done through direct negotiation and transaction between a seller and a buyer. The terms and conditions of the transaction arranged between the concerned parties or they follow one of the internationally accepted standards that have been developed for this purpose by various organizations such as International Emissions Trading Association-IETA, International Swaps and Derivatives Association-ISDA and the European Federation of Energy Traders-EFET. In 2005 transactions OTC held approximately 50% of all transactions in the European market, a percentage that is expected to decline in future as European stock markets will be better organized. It is usually used from small businesses that have limited access to organized emissions exchanges and from companies who want to make a few transactions within the year, usually to cover their position in the national allowances registry. It is not suited for enterprises that have an interest in participating in the international carbon market, as part of the following strategy to manage their emissions. Also for companies which are interested in having multiple transactions in short periods.

Trading of EUAs is subject to the same EU financial market regulation as other financial instruments and trades, and the reason is simple because emissions allowances are traded in the same way as commodities and financial instruments.

Four types of trades can take place in the market, and they are described below.

- **Spot:** This is a trade where the settlement of the trade (payment and delivery) is intended to take place 'on the spot.' Generally, the spot date should be within two business days after the trade date (the date the sale is agreed). The settlement price (or rate) is called the spot price. A spot contract is in contrast with a forward or futures contract where contract terms are agreed now, but delivery and payment will occur at a future date.

- **Futures:** This is a financial contract, between two parties, obligating the buyer to purchase or the seller to sell a specified amount of carbon units for a price agreed today (the futures price or strike price) with delivery and payment occurring at a specified future date, the delivery date. The contracts are standardized to facilitate trading on a futures exchange, which acts as an intermediary between the two parties.

- **Forwards:** A forward contract is similar to a futures contract. A forward contract is a customized contract between two parties to buy or sell a specified amount of carbon units at a specified price on a future date. Forwards are different from a futures contract. Forward contracts do not trade on a centralized exchange and are therefore regarded as over-the-counter (OTC) instruments, rather than via exchange.

- **Swaps:** A swap is a derivative contract. This is a contract to exchange one security for another. In the commodities market, a swap allows a party to change its exposure or risk from 'floating' prices to 'fixed' prices, or vice versa. However, in the carbon market, it can also be as simple as swapping an amount of EUAs for an equivalent number of Kyoto carbon credits. Both types of the

unit can be used for compliance in the EU ETS, but carbon credits (e.g. CDM credits) sell at a discount to EUAs. The seller of the EUAs receives not only the credits in return but also the price differential between the two units, thereby reducing the overall cost of complying with the EU ETS.

- **Options:** An option, represents a contract sold by one party (the option writer) to another party (the option holder). Options are about giving buyers of the option the right, but not the obligation to buy or sell allowances at a fixed price upfront(the strike price)during a certain period of time or on a specific date. A call option gives the buyer of the call option the right, but not the obligation, to buy emissions allowances at an agreed price. A put option allows the buyer of the put option the right, but not the obligation, to sell allowances at a fixed price agreed upfront. Options are a useful way of locking in a price or an avenue of sale when there is a risk that market conditions could move in the opposite direction as originally anticipated.

2.3 Types of emissions trading schemes

Emissions trading is a market-based approach to controlling pollution, to combat climate change and to reduce industrial greenhouse gas emissions cost-effectively. By creating tradable pollution permits, it attempts to add the profit motive as an incentive for good performance, unlike traditional environmental regulation based solely on the threat of penalties. There are many emissions trading systems, which aim to provide the stakeholders the flexibility to determine the most economical way to reduce their emissions. The variations of systems are based on the kind of the trade product, but also on the purpose for which the market was created. There are many different market-based instruments, but the most successful are the quota trading. Quota trading can reach environmental targets cost effectively. This opened the way to more inspired programs like cap and trade.

- At **cap and trade** program the cap sets a maximum allowable level of pollution that participating units can emit in one year. The cap is set by a central authority (usually a governmental body). After the cap has been determined, allowances for portions of the total limit are allocated and are freely traded. When a unit emits less than its allowances, it can sell its excess allowances. On the other hand, when a unit emits more than its allowances, needs to buy allowances to cover its excess emissions. At the end of the year, units are required to hold permits in an amount equal to their emissions. Units that exceed their emission allowance are penalized. By setting a limit on pollution and then letting the market make the decision how to stay within that limit, it's ideally suited to reducing emissions. The market should ensure that the cap can be lowered year by year in a managed way and the emissions cuts happen at the lowest possible cost.

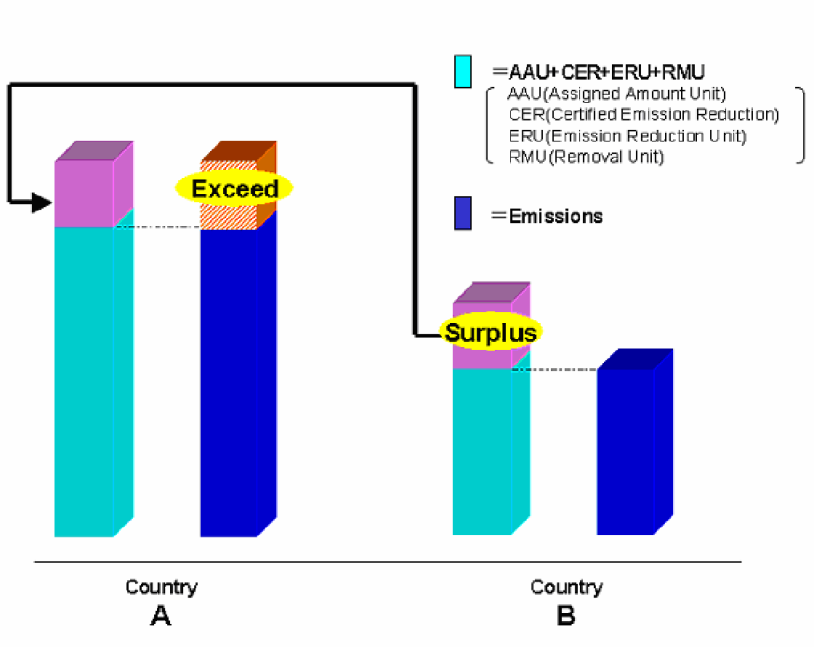
- **Bubbles:** Allow a company with multiple emission sources to combine its total emissions targets of these multiple sources within a single accounting system. This creates the flexibility to apply pollution control technologies in any source that has the most cost-effective ability of pollution control while ensuring that the total amount of emissions for sources that are included in the flexible package, will agree with overall environmental constraints of the company.

- ***The trading of offsets or credits****:* or in other words credit-based emission reduction, expresses another aspect of emissions trading. These systems take into account each installation separately (project-based), often including industries and companies without emission ceiling (non-capped). Such a system allows companies who are wishing to increase their emissions to gain additional reductions by companies who do not need to reduce their own emissions. The credits are created when a corporation who emits pollutants, achieves voluntarily permanent emission reductions that are legally acceptable by the regulator as "emission reduction credits." These credits sold to sources to offset their new or additional emissions. The regulators accept each of any transaction. However, they usually demand that a percentage of credits has to be withdrawn as a dividend to the environment.

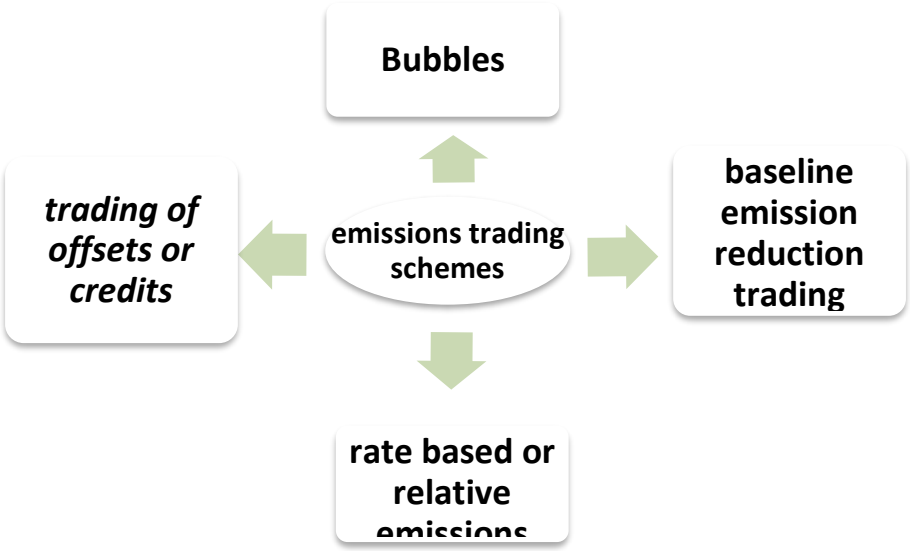
- The **baseline emission reduction trading systems** that take into account each installation separately (project-based) and they are usually followed by industries and companies without an emission ceiling. Such a system allows a company to voluntarily reduce its emissions below a baseline, without taking any additional measures. The system based on the difference between two emission forecasts: with and without the suggested project. The Clean Development Mechanism (CDM) of the Kyoto Protocol is based on such a system

- The **rate based or relative emissions trading** focus on emissions per production unit, rather than absolute emissions. This system aims to promote raised production yields, without restrictions on the company's development. Through such a system, the businesses that improve their yield beyond their targets can then sell the excess to other companies. For example, a car manufacturer can make changes to the produced cars, providing an overall average improvement in fuel consumption per kilometer per sold car.

Image 7: Emissions trading schemes



The function of the cap and trade system is being described by the image that follows.



2.4 Europe's energy markets

In Europe, they have operated five energy exchanges. The EEX (European Energy Exchange), based in Germany is the largest and most prestigious trade of emissions. The European Climate Exchange (EXC) based in the Netherlands, is a pan-European platform for Carbon dioxide emissions trading futures based on EU emission allowances (EUAs) and Certificated Emission Rights (CER). The Bluenext is the European environmental trading exchange, considered the largest CO2 permit spot market, based in France, founded in 2007 when the NYSE EuroNext and Caisse Des Depots bought the carbon market from Powernext. On October 26, 2012, BlueNext announced that it would close its spot and derivatives trading operations permanently as of December 5, 2012. The Energy Exchange Austria (EXAA) is a Central European energy exchange headquartered in Vienna. Currently, the EXAA Market encompasses trading areas in the entire of Austria and Germany. It was founded on June 8, 2001, and includes spot transactions energy. Since the end of 2012 more than 70 companies traded on the spot energy market. Finally, Nordpool is the largest electricity market, based in Oslo, Norway. More than 70% of consumption of the total electricity is traded through NordPool. EUAs and CERs are traded on the spot market and on the derivatives market where there are forward, future and option contracts.

Table 3:The main European stock markets

STOCK MARKET	COUNTRY	PRODUCT
European Climate Exchange(ECX)	Netherland	Spot, future, option
Nordpool	Norway	Spot, future
Powernext	France	Spot
European Energy Exchange(EEX)	Germany	Spot, future
Energy Exchange Austria(EXAA)	Austria	Spot

Sources:

Carbon emission trading is a method that most of the countries use in order to meet their obligations specified by the Kyoto Protocol. In a carbon market, the target is carbon dioxide, and it's calculated in tons of carbon dioxide equivalent or tCO2e. The carbon market it's a ΄cap΄ and ΄trade΄ market. When a country is having more emissions of carbon, than the limit is, is able to purchase the right to emit more and when a country having fewer emissions

sells the right to emit carbon to other countries. Except the European trading system, national or subnational systems are already operating or under development in Britain(Carbon Reduction Commitment-CRC) Canada, California, China, Kazakhstan Japan, New Zealand, South Korea, Switzerland and the United States(Regional Greenhouse Gas Initiative-RGGI).

Image 8: Carbon emission trading

Sources:*(EuropeanCommission,n.d.)*

https://ec.europa.eu/clima/sites/clima/files/docs/ets_handbook_en.pdf

There are four different major markets for trading with GHG emission allowances/reductions:

- ✔ Kyoto Protocol: where developed countries can trade Assigned Amount Units (AAUs). Moreover, countries can also purchase project-based emissions reductions through JI and CDM.
- ✔ EU Emissions Trading Scheme: limits emissions of 12.000 large-scale emitters within the EU by allocating allowances (EUAs) which can be traded on a Europe-wide market. The EU-ETS and the Kyoto protocol are linking, and that allows emitters under the EU-ETS to buy

- Certified Emission Reductions (CER) which are emissions certificates issued by bodies of the UN Framework Convention on Climate Change and the Kyoto Protocol for the successful completion of Clean Development Mechanism (CDM) climate protection projects

- Emission Reduction Units (ERU) which are emissions credits that are issued for the successful completion of Joint Implementation (JI) projects and CDM.

1. Canada Greenhouse Gas Offset System: it includes a domestic trading system for large-scale emitters and allows the purchase of CERs/ERU.

2. Japan (voluntary trading system): A voluntary trading system but Japan intends to purchase large volumes of CERs/ERUs.

In reality, usually, emitters buy CER or ERU from project proponents once they have been generated (long-term forward purchase agreement). It is less common to invest in a CDM or JI project and receive (part of) CER as return on investment.

2.5 EU Emission Trading System

2.5.1.Introduction

In order to combat climate change and meet emissions reductions targets, European Union uses the Emissions Trading System (EU ETS). The EU ETS represents the backbone of the European Union's climate policy efforts. The system was first introduced in 2005 and has undergone several changes since then. The European Emission Trade System is an operational model of emission trade system, which is being continually upgraded and adopted by other countries. The most recent renewal of the system was about the import of the emissions from the Airplanes (Aviation) in the community scheme EU- ETS. The right to trade European allowances (EUAs) has, principally, anyone with an account in the EU. In practice, trading is mostly done by energy and industry companies with obligations under the ETS. As the first and largest emissions trading system for reducing GHG emissions, the EU ETS covers more than 11,000 power stations and industrial plants in 31 countries, and flights between airports of participating countries.

2.6 Main EU ETS features over the years

The implementation of the European emission trading system has been divided up into distinct trading periods over time, known as phases. The preliminary phase (Phase 1) ran from 2005 to 2007, Phase 2 began in 2008 and finished in December 2012, Phase 3 started in January 2013 and will end in December 2020, and finally, Phase 4 will start 2021 until 2028. Phase1 was intended to test and evaluate the performance of the emission market. Phase 2 imposed an emission reduction target in line with the Kyoto Protocol's first commitment period. Phase 3 brought along significant revisions to the system's operational design concerning, in particular, the permit allocation procedure and the imposition of an EU-wide emissions cap. The rules of Phase 4 are still under development.

The first phase of the EU ETS was seen as the pilot phase. This period was used to test price formation in the carbon market and to establish the necessary infrastructure for monitoring, reporting, and verification of emissions. The cap was mostly based on estimates as there was no reliable emission data available. The primary purpose of phase 1 was to ensure the EU ETS

functioned effectively ahead of 2008, to make sure that it would allow the EU Member States to meet their commitments under the Kyoto Protocol. The so-called Linking Directive1 allowed businesses to use certain emission reduction units generated under the Kyoto Protocol mechanisms clean development mechanism (CDM) and joint implementation (JI) to meet their obligations under the EU ETS. In the first phase businesses were only allowed to use units generated under the CDM for EU ETS compliance.

The second phase of the EU ETS ran from 2008 to 2012, the same period as the first commitment period under the Kyoto Protocol. From 2008 businesses could also use emission reduction units generated under JI to fulfill their obligations under the EU ETS. This made the EU ETS the largest source of demand for CDM and JI emission reduction units. Towards the end of phase 2, the scope of the EU ETS was expanded by including aviation from 2012.

The third phase of the EU ETS was shaped by the lessons learned from the previous two phases. In particular, significant efforts were taken to improve the harmonization of the scheme across the EU following a review of the EU ETS, agreed upon in 2008. The third phase runs from 2013 to 2020. This coincides with the Kyoto Protocol second commitment period, as agreed in Doha in December 2012. The EU is one of the jurisdictions that has committed to a target under the second commitment period, and the EU ETS will be key in achieving the target. Nonetheless, the EU ETS is defined by EU legislation and operates independently of the actions of other countries or the UNFCCC, underlining the commitment of the EU to tackle climate change.

The EU ETS has undergone numerous changes over the years. Lessons from previous phases were taken into consideration in the design of the following phase to improve the system continuously:

- The scope of the EU ETS in terms of geography, sectors and greenhouse gasses keep increasing, which enhances the effectiveness of the EU ETS

- The cap in the EU ETS has become increasingly stringent. The cap has been decreasing between phases, while at the same time adjusted in line with changes to the EU ETS scope.

- From phase 2, installations were allowed to use certain Kyoto Protocol emission units – some types of CERs and ERUs- alongside European Union emission allowances (EUAs), subject to quantitative limits.

Others developments in the EU ETS over the years relate to an increased use of auctioning as an allocation method and improvements in rules for free allocation, monitoring, reporting and verification (MRV), registries and market oversight, where one of the overarching themes was the harmonization of regulations at the EU level.

In the first stages of this common trade system the allowances were given away for free, but these days they are being auctioned in the primary and secondary market through the introduction of rights in the European Stock Markets. An example of a complete negotiation of the rights in the primary and secondary market is the auction of the pollution rights at the German Stock Market.

Key features	Phase 1 (2005–2007)	Phase 2 (2008–2012)	Phase 3 (2013–2020)
Geography	EU27	EU27 + Norway, Iceland, Liechtenstein	EU27 + Norway, Iceland, Liechtenstein Croatia from 1.1.2013 (aviation from 1.1.2014)
Sectors	Power stations and other combustion plants ≥20MW Oil refineries Coke ovens Iron and steel plants Cement clinker Glass Lime Bricks Ceramics Pulp Paper and board	Same as phase 1 plus Aviation (from 2012)	Same as phase 1 plus Aluminium Petrochemicals Aviation from 1.1.2014 (aviation from 1.1.2014) Ammonia Nitric, adipic and glyoxylic acid production CO2 capture, transport in pipelines and geological storage of CO2 Aviation
GHGs	CO2	CO2, N2O emissions via opt-in	CO2, N2O, PFC from aluminium production
Cap	2058 million tCO2	1859 million tCO2	2084 million tCO2 in 2013, decreasing in a linear way by 38 million tCO2 per year
Eligible trading units	EUAs	EUAs, CERs, ERUs ***Not eligible***: Credits from forestry, and large hydropower projects.	EUAs, CERs, ERUs Not eligible: CERs and ERUs from forestry, HFC, N2O or large hydropower projects. Note: CERs from projects registered after 2012 must be from Least Developed Countries

2.7 The EU ETS work

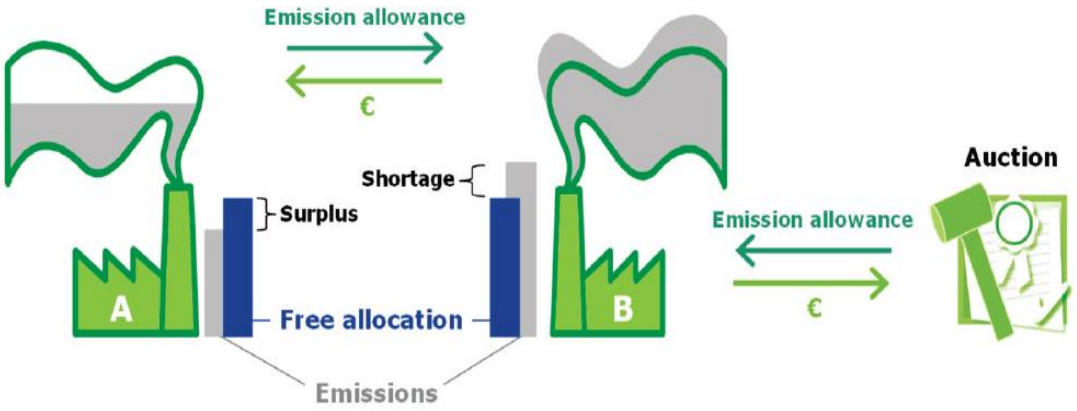
The EU ETS is a 'cap and trade' system, which works by capping the overall volume of greenhouse gasses that can be emitted each year by the power plants, factories and other companies covered by the system. The cap is set at EU level. The EU ETS legislation creates allowances. One allowance gives the holder the right to emit one ton of CO_2 or the equivalent amount of another greenhouse gas. The level of the cap determines the number of allowances available in the whole system. In other words, the cap on the total number of allowances creates scarcity in the market. Emission allowances are the 'currency' of the EU ETS, and the limit on the total number available gives them a value.

Every year the cap decreases, lessening the available number of allowances by 1.74% per year. This permits companies to slowly adjust in order to meet the determined target for emission reductions.

Allocation of allowances is done either by free allocation, where installations receive allowances for free or via auctioning of allowances. 5% of the total quantity of allowances is set aside for free allocation to new entrants. Free allocations are given mainly to the industry sector, but there has been a cap set on the maximum free allocation to industry.

At the end of a year, participants must return an allowance for every ton of CO2e they emit during that year. In case a participant has not enough allowances then it has two options. It must either take measures to reduce its emissions or buy more allowances on the market. Members can obtain allowances at auction, or from each other. A third option is to also buy limited amounts of international credits from emission-saving projects around the world.

Image 9: The EU ETS work



Sources:*(EuropeanCommission,n.d.)*

https://ec.europa.eu/clima/sites/clima/files/docs/ets_handbook_en.pdf

For instance, assuming that factory B has insufficient free allowances to cover its emissions, can either adhere to the cap by buying allowances from factory A or from the auction. Factory A holds surplus allowances, from the free allowances that were given at the start of the year and such can sell them to Factory B. If a participant reduces its emissions, it can keep the additional allowances to cover its future needs.

What is good for business and the economy is the fact that the emissions reductions take place in areas where it costs less. The reason that allowances have value is because there is a limited or capped supply and there is demand for them from those participants for whom the cost of making reductions are higher than for other participants.

If participants fail to meet the requirements by surrendering enough allowances in time, fines are forced. The penalties for non-compliance set at €100/tCO2 and rising with EU inflation from 2013.

2.8 Major elements for successful emissions trading

Allowances behave like property rights. They are sensitive to rule changes that might affect their value. A primary requirement for the market to function is the allocation of property rights to market participants. Coming, constant and fraud-proof monitoring and verification procedures must be put in place. As soon as the allowances are allocated, the market is expected to achieve the environmental objective. EU ETS is undermined by frequent changes in specifications of property rights or other rule changes.

A key criterion, against which the EU ETS is assessed, is the reach of the degree to which it permits market participants to manage carbon risk over the long run, i.e. to evaluate future opportunities or liabilities. A successful market allows predictability for investment and by that means provides the certainty to make efficient investment decisions, e.g. whether to invest in new equipment and reduce emissions or to buy extra allowances. Therefore, there is the need for rules that can be predicted and ideally a long-term target.

Liquidity, transparency and market confidence brought about long-term predictability. Liquidity is associated with the shortage expressed through allocation as well as the number of market participants, including buyers and sellers, but also market-makers such as brokers, speculators, and arbitrageurs. Due to transparency which provides independent information, market participants are able to make informed decisions on whether to buy or sell. Regulatory certainty and political stability are critical factors for market confidence. This includes for

instance transparency about the interactions between the emissions market and other markets, like those for renewable energy certificates and the rules of the international climate regime.

In addition, standardized operations can benefit risk management, for example, transparent market rules to speed up the transition to lower transaction costs. However, this is somewhat not so significant in the context of EU ETS. Typically, if we do not include the treatment of financial transactions, there are no special rules for governing trade. Trading standards are a common part of the general economic and legal framework of market economies. Market participants might have other rules, such as clearing and settlement.

Conclusively equity and general economic impacts are also significant. In order to provide the political stability required by the EU ETS, a sense of a 'fair burden-sharing' between member states, market participants and within societies is essential. If this sense does not exist, there is a risk of adverse political reaction. For example, a perception of unfair burden-sharing within or between sectors, wealth transfer or violation of the 'polluter-pays principle.' As a consequence, the EU ETS would jeopardize. One more precondition of stability is that the environmental objective will be achieved.

2.9The companies join EU ETS

The interest in EU emissions trading has increased. Member states, among them UK and Denmark, companies such as Shell and BP, industrial associations such as Enterprises pour l'environnement and the EU electricity sector were increasingly becoming interested in emissions trading schemes for greenhouse gasses. In the way described further on, these theoretical advantages may have contributed to this European turnaround.

- Initials, emissions trading, in theory, offers the prospect to achieve the environmental target in the most cost-effective way by guaranteeing that the carbon's market price is equal to the lowest marginal abatement cost amongst all controlled sources. In addition, emissions trading offers flexibility. Basically, emitters (factory operators, oil refineries, power plants, etc.) are provided with a mechanism by which can find the most cost-effective ways to cut down their emissions. By factoring carbon-reduction strategies into everyday business decisions, emissions trading would go beyond existing environmental policy, mainly seen as an inevitable overhead.

- Secondly, another possible advantage is the improvement of long-term predictability from the resulting (forward) carbon price. Predictability is a critical factor for firms, as they base their investment decisions on it.

- Third, distortions to competition in the EU market are expected to decrease because of the emissions trading, as it enforces an EU-wide carbon price for all industries alike.

- Another cap-and-trade advantage is that keeps transaction costs low by allocating unambiguous property rights and ensures environmental effectiveness as emissions are capped

- Moreover, as long as there is a free allocation of allowances, businesses collect extra revenues, which partly or entirely balance higher production costs thanks to the EU ETS.

- At the same time, environmental certainty is provided by a cap-and-trade system such as the EU ETS. EU ETS caps the overall emission level from the covered sources.

- Such a system is suitable for the implementation of the Kyoto Protocol targets which are also expressed in absolute terms.

These theoretical economic and environmental advantages of the least-cost abatement long-term predictability, flexibility, management focus and environmental certainty – rely on, however, to a considerable degree on the market architecture, relating both to the legislative (i.e. the EU ETS directives) and implementation phases (i.e. implementation by member states under European Commission supervision. It is the allocation of allowances on the one hand and the functioning of the market (i.e. rules and compliance with them and interaction with others, such as power markets) on the other that are critical for the efficiency of the EU ETS.

Implementation should be guided by the aim to achieve the environmental objectives of the EU ETS without jeopardizing the competitiveness of EU industry

2.10 Benefits

The trading approach is the most cost-effective and economically efficient manner. The EU Emissions Trading System is a 'cap and trade' system. It caps the total volume of GHG emissions from installations and aircraft operators responsible for around 50% of EU GHG emissions. The scope of trading emission allowances is that the total emissions of the installations and aircraft operators stays within the cap and the least-cost measures can be taken up to reduce emissions

"Cap-and-Trade" system was chosen by the EU not only because it is the best way to meet the GHG emissions reduction target at least overall cost, but also for the reason that sets an environmental outcome at lowest costs. Another option could be a traditional command-and-control approach which may mandate a typical cap per installation but provides little flexibility to companies as to where or how emissions reductions take place. In a multi-national system, tax is not an assurance that the GHG emissions reduction target will be accomplished. All countries would have to agree on the right price for carbon, which is not an easy thing to determine. In contrast to traditional 'command and control' regulation, emissions trading uses market forces to find the cheapest ways of reducing emissions

By trading companies have the advantage to decide what the least-cost option is for them to meet a fixed cap. The carbon price is then set by the market through trading and based on a wide range of factors.

The cap-and-trade structure was chosen for the EU trading system because of the flexibility that offers but there are also other benefits:

• ***Revenue***: Governments earn for GHG emissions allowances auctions at least 50% of which should be used to fund measures to combat climate change in the EU or in the other Member States.

• ***Certainty about quantity***: EU ETS directly restricts GHG emissions by setting a system cap which is designed to assure compliance with the important commitment. The maximum quantity of GHG emissions is certain for the period of time over which system caps are set.

• ***Minimizing risk to Member State budgets***: The risk that the Member States will need to buy extra international units in order to meet their commitments to Kyoto Protocol is minimized due to the reason that EU ETS provides certainty to emissions reduction from installations responsible for around 50% of EU emissions.

• ***Cost-effectiveness*****:** Due to the flexibility that the trading brings, all the companies face the same carbon price and assure that emissions are cut where it costs least to do so

2.11 The impact of carbon emissions trading on firm competitiveness productivity and profitability

The introduction of necessary controls and a trading scheme covering approximately half of all carbon dioxide emissions in Europe has triggered a debate about the impact of emissions trading on the competitiveness of European industry. Economic theory suggests that, in many sectors, businesses will pass on costs to customers and make net profits due to the impact on product prices combined with the extensive free allocations of allowances

Competitiveness

The meaning of competitiveness at the business level mentioned as the ability to attract customers and to maintain or increase market share. Companies compete through two parameters: the final price of the product, which is determined by the cost of production, and through differentiation. For one to examine the effects of environmental policy (introduction of new or increasing the degree of severity of the already applied) in industrial competitiveness is necessary. Regarding the relationship of environmental policy and industrial competitiveness with emissions trading, compliance to strict environmental regulations leads to an increase in production costs and consequently a blow to the company's competitiveness.

However, there is a different view, which is based on incentives given to industries for application innovations that can offset the costs of compliance. The strict environmental policies contribute to the creation and increase competitive advantage. For instance, pressuring

industries to improve the quality and the technology of products. Substantial gain is induced by strict environmental regulations which preempt standards which will be inflicted internationally. Countries which apply these regulations have an advantage regarding the development of products, processes, and environmentally friendly technologies.

Productivity

Emissions trading effect on productivity is considered to be negative as the demand for controlling pollution increases the costs of inputs while the level of produced product remains constant. On the other hand, according to economic theory, in many industries, businesses will pass on the cost to consumers and will make a net profit due to the impact on product prices combined with the free allocation of carbon allowances on the stock market.

Profitability

In a survey conducted in 2006 by Smale[1], they found the effect of the EU ETS on the competitiveness of UK businesses and the potential impacts on prices, sales volumes and firms' profits and their competitors. According to the results, the EU ETS reduces the emission level and has a positive effect on EBITDA (Earnings before Interest, Taxes, and Amortization). This due to the fact that companies respond to the rise of marginal costs, which is a result from the EU ETS, by reducing their product activity, so to increase the price in order to cover the extra cost, and benefit from the free allocation of permits, through grandfathering.

Investments

The EUA market comprises various energy generators and industrial sectors with differing emissions profiles, abatement capacity, exposure to international competition, and capacity to influence allowance prices. In a survey conducted in 2011 by Ralf Martin, Mirabelle Muûls, and Ulrich Wagner[2], found a significant proportion of firms are pursuing some measures to reduce GHG emissions. For a majority of these (more than 60%), this includes energy- and GHG emissions-saving measures related to their machinery and core processes. Moreover, about 30% of firms that are part of the European Union Emissions Trading System only participate passively in the market; i.e. they do not consider carbon allowances as a financial asset providing opportunities. Rather, they see the cap implicit in their allowance allotment as something they merely need to comply with. Finally, the majority of the 446 EU ETS participants do not trade on the EU ETS allowance market. Some of these firms do not need to because their emissions do not exceed the number of allowances they were allocated. Those companies do not make their excess allowances available on the market. On average, firms start to sell only if they have an excess supply of 5,000 to 10,000 allowances.

[1] Smale R. et al. (2006), "The Impact of CO_2 emissions trading of firm profits and market prices",

[2]

2.12 Buy or invest

European companies, taking part in the emissions trading system face the choice to either reduce their emission through reductions in production or through investing in carbon-avoiding technologies or purchasing allowances to release GHG emissions, or generate additional allowances by investing in clean projects under the Clean Development mechanism or the Joint Implementation mechanism, or otherwise, to pay the penalty

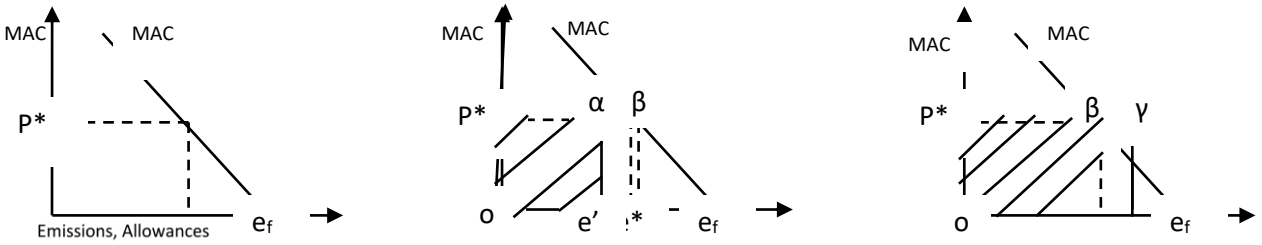
The price of certificates is a major factor for a company to decide whether or not to make an investment. The profitability of such an investment relies heavily on the development of the allowance price. Investment risk arises, as the elaboration of the allowance price characterized by uncertainty. Hence, the question is raised for the company as to whether it can bear the risk associated with a specific investment decision if there is sufficient equity. Therefore, it is necessary to determine the CO2 certificate price risk before making decisions with regard to investment alternatives that can be taken.

Within a period of trade, there are certain amounts of certificates available. Anyone involved in the emissions trading system, as well as companies, have the right, the opportunity to consume the assigned certificates for their own emissions and to sell the leftover or to buy missing certificates on the market. It may be beneficial for companies to invest in CO2-avoiding technologies if the unused emission rights can be sold at a high price. However, if the costs of emission avoidance decisions in own businesses (or alternative investment in the context of JI or CDM) is higher than the prices of adequate emissions certificates; it is profitable for the company not to invest. Rather than investing, companies will purchase allowances or certificates on the market. As all market participants face the same decision, the prices for certificates of a trade period reflects the "make or buy"-decision of all market participants. The price of certificates (P) for one period of trade shall, therefore, be defined by the last and consequently most expensive entity of CO2-emissions to be reduced. These costs are the marginal abatement costs (MAC). The current market price should be equal to the marginal avoidance cost for the period. (P=MAC)
It is logical that the abatement costs of CO2-emissions of one trade period can only be precisely determined at the end of this period. This is done because only at that time it is known how much CO2 was actually avoided and at what cost. Before that point in time, no one knows how high the marginal abatement costs will actually be, and only expectations about these can be formed.

- Supposing that the initial allocation of the allowances it is not the same with the allocation through the company achieves cost-minimization, it is expected that: Companies with high marginal abatement cost purchase allowances and
- Companies with low marginal abatement cost sell allowances.

Horizontal axis: emissions and allowances (e)
e_f: company's initial emissions before ETS
P*:market price for buying allowances

Diagram 1 Diagram 2 Diagram 3



e* e* e''

From the emissions trading are mainly benefit companies with low reduction cost for emissions which are expected to directly join the trading system in order to profit from the sale of emissions rights. These companies reduce their emissions more than the legislation state and then sell the surplus emissions reductions at enterprises that face higher reduction cost.

Obviously, if the market value of transferable emissions permits exceeds the reduction cost of emissions, any unit has a high motivation to reduce its emissions regardless of the limits that law demands.

Diagram 1: This diagram reflects the market equilibrium, the best option for a company at the emission trading scheme

Diagram 2: At this diagram, the company has allowances equal to e'. At the left of e*, the best option for the company is to purchase allowances. The reason is because the marginal abatement cost is higher than the price market for allowances. It is cheaper for the company to buy allowances than reducing its emissions. If the company decides to make the investment, then it will pay until reach the MAC line, if it decides to buy allowances it will pay until reach p* line. (op*α e')< (op*βe*)

Diagram 3: At this diagram, the company has allowances equal to e''. At the right of e*, the

best option for the company is to make the investment and not to buy allowances. Here the marginal abatement cost is lower than the market price for allowances. In this area the company sells allowances. (op*βe*)<(op*γe'')

The main advantage of emissions trading is the economic efficiency at the same time with the environmental targets achievement.The economic cost is kept low compared to other regulatory tools, such as taxes, while the environmental goals are being achieved.

2.13 How emission trading reduces compliance company cost-example

The following example analyzes how the emission trading system reduces the compliance cost for a company. Supposing that the regulating authority demands reduction of 10% of total emissions for one pollutant, 150.000 ton, which are currently emitted by two industries A and B.

Table 4: Emission reductions demands from the regulator authority

Emission reductions demands from the regulator authority			
	Industry A	Industry B	Total
Current emissions	50.000tn	100.000tn	150.000tn
Demands of reductions	5.000tn	10.000tn	15.000tn
Emissions after the reduction	45.000tn	90.000tn	135.000tn

One common regulatory authority could, for example, demand from every industry the reduction of the emissions based on the required amount or could force the use of a specific technology for the achievement and maintenance of reduction. Suppose that the one industry could achieve the reduction target (10%) with cost 10.000€, while for industry B the cost of reduction will be 50.000€ for the same percentage. This means that the total cost will be 60.000€ as seems below.

Table 5 : Allocation of reduction emission cost based on regulatory authority-compliance cost

Allocation of reduction emission cost based on regulatory authority			
	Industry A	Industry B	Total
Emission reduction	5.000tn	10.000tn	15.000tn
Cost per ton (MAC)	2€/tn	5€/tn	15.000tn
Total compliance cost with the regulatory authority	10.000€ (= 2€/tn ×5.000tn)	50.000€ (= 5€/tn ×10.000tn)	60.000€

Now, what will happen with the implication of an emission trading system?

Industry A, which has low reduction cost for emissions, applies more emissions reductions than the required percentage and sells the surplus to industry B, which has higher reduction cost for emissions. The example supposes that industry A can reduce its emissions about 10.000tn with cost 2€/tn and further reductions (more than 10.000tn) will fulfill with cost 5€/tn. Industry A makes a reduction of 10.000tn, but it needs only 5.000tn according to the percentage that is forced from the regulator authority. This means that industry A has allowances for 5.000tn that can sell to industry B. The price of the allowance will be between 2€/tn (the cost for emission reduction for industry A) and 5€/tn (the cost for emission reduction for industry B). Suppose that this price finally equals to 3.5€/tn while industry B has to reduce its emissions 5.000tn more, according to the percentage that is forced from the regulator authority.

Table 6 : Allocation of reduction emission cost based on regulatory authority

Allocation of reduction emission cost based on regulatory authority			
	Industry A	Industry B	Total
Allocation of emission allowances	45.000tn	90.000tn	135.000tn
Emissions reduction	10.000tn	5.000tn	15.000tn
Emission reduction cost	20.000€	25.000€	45.000€
Sold allowances	5.000tn		
Purchased allowances		5.000tn	
Price per allowance	3,5€/tn	3,5€/tn	
Revenue from sold allowances	17.500€ (=3,5€/tn×5.000tn)		
Expenses from Purchased allowances		17.500€	

Compliance cost with ETS	20.000€−17.500€	25.000€+17.500	
	2.500€	42.500€	45.000€

The total compliance cost for industry A, after the deduction of revenues from the sale of allowances is 2.500€ ⇒saving 7.500€ or 75 %.

After adding the purchase cost for allowances, the total compliance cost for industry B is 42.500€ ⇒saving 7.500€ or 15%.

Table 7 : Allocation of reduction emission cost based on regulatory authority-compliance cost percentage

Allocation of reduction emission cost based on regulatory authority			
	Industry A	Industry B	Total
Emissions reduction	10.000€−2.500€	50.000€−42.500€	60.000€−45.500€
Cost per ton (MAC)	7.500€	7.500€	15.000€
Total compliance cost with regulatory authority	75%	15%	25%

CHAPTER 3

3.1 Risk management

Management is the planning, coordination, and organization of all functions, through strategic, operational projects (business plan). By the term strategic business plans, we mean the study of the development of a company, bank or organization. It includes the analysis, diagnosis, and assessment of the environment of each business, identifying the opportunities, and also the analysis, assessment of its strengths and weaknesses. The factors that influence the functionality of the Business Plan could be defined as risks. Sometimes these risks make the implementation of the Business Plan impossible, and they can come either from the inside or the outside environment. The probability of some undesired event at some time is defined as a risk unit and results in higher costs. The risks are multidimensional and interconnected. Risk Management is a new science, and it is essential to business policy.

Risk management is based on the identification, analysis, control and so it becomes a more efficient response to those events that have the ability to cause an undesirable change in the Business Plan. It is, therefore, necessary to develop the appropriate, for each risk factor, methodology to assess and address the risks by offering an option which allows and encourages the Business Plan to develop despite all the corrective changes.

In this chapter, it will analyze the effect on production and profits in the European cement industry from different approaches of the allocation of emission allowances.

3.2 The cement industry

Cement is one of the most produced materials around the world and considered as the primary building material. Cement is mostly used for the production of concrete. Concrete is a mixture of inert mineral aggregates, e.g. sand, gravel, crushed stones, and cement. Economic activity is closely related to construction activity and therefore to cement consumption and production in general.

As a consequence, cement manufacturing, cement production is a highly energy-intensive process. The energy consumption by the cement industry is estimated at 2% of the global primary energy consumption, or almost 5% of the total global industrial energy consumption.

On the other hand, due to the dominant use of carbon-intensive fuels, e.g. coal, in clinker making, the cement industry is also a major contributor to global anthropogenic CO2 emissions.

It is significant that the cement industry represents around 10% of world emissions because world cement production has been increasing steadily over many decades and due to the very high carbon emissions per ton (both from fuel combustion and from the process itself).

Carbon dioxide emissions in cement manufacturing derive from two sources: fossil fuel combustion and the calcination of the principal limestone raw material. Over 50% of the CO2 emissions in cement production results from calcination, and around 40% of the CO2 result from combustion of the fossil fuels that supply the energy for calcination. Indirect CO2 emissions due to the use of electricity that is generated by fossil fuel combustion account for about 5% of the total emissions.

As for, cement industry sector is in a serious manner one of the most impacted by a climate policy: among twelve EU-15 industry sectors, non-metallic minerals – mostly cement – have the second highest direct CO2 emission/turnover ratio, just after power production

3.3 Allocation types

Allocation is defined as the initial distribution of emission allowances. For ETS allocation emerged as the key (political) debate. The reason why is because allocation is a distributional issue, and distributional issues are the ones that drive policy making processes. Also, the nature of distributional issues changes over time. Allocation is important because it can also have an impact on the efficiency of an ETS (for multi-period schemes with updated allocation − for systems with new entrant allocation)

The general allocation options are:

Free allocation

- grandfathering (based on emissions)
- benchmarking (based on activities)

− Auctions and sales

(Free) allocation to …

− Incumbents

− New entrants

Eligible entities for (free) allocation

− ETS-regulated entities

− Consumers (of regulated entities)

− Other entities

3.4 Modeling

In their research article Damien Demailly and Philippe Quirion 2006, are modeling an emission trading scheme (ETS) with two different allocation methods. It is about two extreme cases, knowing that the actual allocation method in the EU ETS stands somewhere in between them: The first scenario is with pure grandfathering (GF) allocation and the second with output-based allocation (OB).

Grandfathering – refers to the practice in which allowances are initially allocated to the market participants based on their historical emission profiles. In other words, the number of allowances a firm gets is independent of its current behavior.

Output based allocation- the number of allowances firm takes, is proportional to the firms' current production level. In its pure form, this allocation method is currently excluded by the Commission, but it does incorporate some features of the real-world allocation method.

Main assumptions have been used in most assessments of the EU ETS and so were here. It is assumed that firms take into consideration the value of allowances into their marginal production decisions, regardless of how many allowances they get for free, i.e., they act as if they were covered by an emission tax or auctioned emission allowances. Such a behaviour is in agreement with profit maximization on condition that the firm gets free allowances which are irrespective of its current action (especially its production level): freely allocated allowances have an opportunity cost, so it is rational to add them to the marginal production cost as if the firm had to buy them through an auction or on the market.

To study the effects of these two different allocation methods, on the EU-27 cement industry Demailly and Quirion used CEMSIM-GEO model, which is a trade model they developed to handle similar products with high transportation costs such as cement.

There are many different prices for cement around the world, and this is caused by the importance of transportation costs. The transportation cost is a characteristic that must be taken into consideration when evaluating the influence of an asymmetric climate policy on the cement industry, whereas coastal regions could be severely impacted, inland ones seem to be relatively protected. For example, a ton of cement is sold around 80euros when it leaves a plant in France, and it costs 10euros to transport it by road over 100 km. The cost is much lower by sea.

In the GEO model, the world is divided into more than 7,000 areas, and the same setting that was inspired by Brander (1981) and Brander and Krugman (1983) takes place here. A Cournot oligopoly competition is assumed to be held in every area among all the producers of the world, where demand is assumed to be linear. Moreover, manufacturers are subject to a capacity constraint. When its capacity constraint is binding, a producer gives priority to its national areas and sells its production in the most profitable areas. A cement firm may extend its available capacity to export by using plants located more deeply inside its territory, and consequently by increasing production cost through higher transportation costs. However, its exports are capped by its total capacity.

CEMSIM is a model of the cement industry, developed by the IPTS (Szabo et al.2003, 2006). It pays particular attention to fuel and technology dynamics. Seven technologies are included, characterized by energy, material and labor consumptions, an investment cost, and a set of retrofitting options.

3.5 Results

A simple theoretical model is used to understand how the two allocation methods differ. Assume *N* homogeneous firms competing under Cournot competition with a linear demand curve on the goods market. These firms choose an output and an abatement level in order to maximize their profit.

$$Max = P(Q)q - q \cdot c(ua) - (e - gf - q \cdot ob)$$

With

$$e = q(ue_o - ua)$$

$$Q = \sum_{N} \quad q$$

$$P(Q) = a - b \cdot Q$$

where $P(Q)$ is the inverse demand, decreasing; Q the aggregate output; q a firm's output, c the marginal production cost, assumed constant with respect to production and increasing with *ua* (for unitary abatement), which is the abatement level per unit of output; *PCO*2 the allowance price, assumed exogenous, *e* the level of emissions per firm, *gf* the amount of allowances grandfathered (if any) to a firm, *ob* (for output-based) the amount of allowances distributed for each unit of output (if any), *ue*0 the baseline unitary emission and $a > 0$ and $b > 0$ are the parameters of the demand curve.

Results

After examining the case of pure auctioning by setting both *gf* and *ob* to zero and grandfathering, by setting *ob* to zero; and at last output-based allocation, by setting *gf* to zero, with profit maximization leading to first-order conditions, the results are the following

• **Under auctioning or grandfathering**:

Firms factor the value of emissions per unit of output to their marginal production cost. Furthermore, the marginal production cost increases with abatement, which raises the output price further. To what extent these extra costs are passed on to consumers depends on the number of firms N.

The grandfathered allocation method does not influence either the output price or the output level. This is because grandfathered allowances have an opportunity cost.

Grandfathering increases the profit level.

Output-based allowances

Reduce the price level and increase the output.

3.6 Cost effectiveness

✔ Grandfathering allocation

The cost-competitiveness of firms is determined by the extended cost. The extended cost is the cost with which firms compete on world cement markets, minus transportation costs, expressed in Euros per ton of cement.

Extended cost = variable production cost + CO2 opportunity cost

CO2 opportunity cost = CO2 price * emission per ton of cement (unitary emission)

The opportunity cost increases with the CO2 price, and the rise is less than proportional. When the CO2 price increases, cement producers are pushed to reduce their unitary emission by

1. diminishing the clinker content of cement – clinker being the CO2-intensive intermediary product in cement production,
2. switching from high to low carbon-intensive fuels, and
3. Using more energy efficient technologies.

As a result, the extended cost rises and this increase not only leads EU firms to reduce their output but also impacts their cost-competitiveness compared with that of foreign firms

✔ Output-based allocation

The extended cost, under OB, is defined by:

Extended cost = variable production cost + CO2 price*(unitary emission – OB allowance)

If the amount of output-based allowances allocated covers producers' emissions: they are neither buyers or sellers on the CO2 market, and their extended cost simply equals their variable production cost.

Whereas firms buy some emission allowances for lower CO2 prices, from d30/tCO2, the average unitary emission in the EU is lower than the amount of allowances allocated per ton of cement. Cement manufacturers become sellers on the CO2 market, which supposes that there are buyers such as the power suppliers.

As a consequence, even though the EU variable production cost rises, its extended cost slightly decreases. It is obvious that this result depends on the allocation per ton of cement: for a decreasing allocation, results tend to get closer to the GF case.

To highlight this point, the cost-competitiveness of EU firms, i.e., the extended cost of the firms, is profoundly impacted under GF allocation, it is not under OB for an output-based allocation.

These results, as well as the following (except EBITDA), are independent of the amount of GF allowances allocated.

3.7 Prices

- Grandfathering allocation

The average price applied by EU firms in their countries of origin increases significantly, following the rise of their extended cost. The oligopolistic competition and international pressure are the reasons why the cost pass-through is limited. On average 75% of the extended cost rise is passed on to consumers. Around half of this limitation is due to oligopolistic competition, the other half to international pressure.
However, if the margin over the extended cost tends to decrease, the margin over the variable production cost increases.

- Output-based allocation

As mentioned above, the extended cost of EU firms under OB is not importantly affected. The same applies to the domestic price.

However, if the margin over the extended cost remains quasi-constant, the margin over the variable production cost decreases slightly because of the latter increases.
It is obvious that these results depend on the number of allowances allocated per ton of cement.
Cement prices are not significantly affected

To sum up, under the grandfathering allocation scenario, the EU domestic price and the margin over the variable production cost increases significantly. Under the output-based allocation scenario (over 75% of unitary emission), the EU domestic price and the margin over the variable production cost are weakly impacted.

3.8 Consumption, production, and trade

- Grandfathering allocation

As mentioned above the effect on cement price in the EU under grandfathering allocation is highly important. However, the effect on the consumption is not significant and the reason why is the low elasticity of price demand. Whereas the elasticity is higher, so is the impact on consumption.

On the other hand, EU cement trade is affected by the cost-competitiveness drop of EU producers. Regarding imports, if we assume that no emission trade system is applied, EU countries import 11% of their cement consumed. A percentage of 75% of these imports are coming from other EU countries. With the ETS applied, EU countries import 18% of their consumption, of which 75% comes from non-EU countries. Regarding EU exports, they are halved and focus mainly on other EU countries –90% of exports vs. 70% in not ETS applied.

The trade impact depends on the regional dimension within Europe. In the countries with high rates of import from non-EU countries before the implementation of a climate policy, imports have already deeply penetrated their territory. Therefore, they are less protected by transportation costs and are more sensitive than countries with low rates of non-EU imports.

Another factor that should include when assessing the trade impact is the size and location of the country and the location of its population. For instance, due to transport costs, inland countries or large countries with the population living mostly inland are proportionally less impacted than small countries near the coast and on its extended cost increase.

- Output-based allocation

Under Output-based allocation, EU consumption and imports are highly affected. The same applies for exports. It is important to mention that in the case of tighter output-based allocation this does not hold.
As a consequence, if the impact on consumption is small because of the very low elasticity price of demand (and insignificant under OB), the impact on net import and production is great under GF, and the protection afforded by OB allocation declines if the allocation is under 75% of unitary emissions.

3.9 Operating profitability (EBITDA)

- Grandfathering allocation

In case of grandfathering allocation, EU companies see their production decreasing

EBITDA on cement = ΣWorld areas (Price – Variable cost – Transportation cost)*Production

The result is that the EBITDA on cement increases with low CO2 prices and then decreases.
, simply the 'profit on emission' which is the net profit realized on the emission market, is given by:

Profit on emission = (GF allocation – CO2 emission)*CO2 price

It is important to mention that this is the only output of the model presented here which depends on the volume of GF allocation. The amount of the allowances determines the final effect. For example, under a Grandfathering allocation equal to 90% of historic emissions, cement firms emit less than their allocation. The reason why is because, as it was mentioned before, their production and their unitary emission drop enough for all the CO2 prices tested. Thus the role that they have on the CO2 market is sellers. As a result of this, their profit on emission is positive. Finally, their emissions decrease and their profit on emission increases with rising CO2 prices. It is logical then, that the total EBITDA increases significantly with CO2 prices, as does the share of profit arising from emission sales.

It is obvious that the outcome depends strongly on the amount of GF allowance allocated. For example, if assumed allowances equal to 50% of 2004 emissions, EU cement manufacturers, instead of selling CO2 allowances as they were before, now buy CO2 emission allowances. However, this remains more than offset by the value of the higher prices, and their EBITDA still rises. Nevertheless, at allocations below 50%, the EU cement companies lose.

- Output-based allocation

Under output-based allocation, the margin over variable production cost decreases.

Regards to EBITDA, when the CO2 prices are low, then the impact is not significant. However, when the CO2 prices are at higher levels and in spite of the small production rising, the EBITDA for EU cement firms decreases.

As it was mentioned before, for CO2 prices equals to 20€/TCO2, EU cement producers turn out to be neither sellers nor buyers. However, when the prices are at higher levels, the firms sell the extra allowances, and they benefit from the emissions sales.

Profit on emissions = (OB allocation – unitary emission)*production*CO2 price

This outcome of the equation is positive and increases with the price because the manufacturers sell more and at a higher value. The total effect on EBITDA is not important under OB-90%, even for high CO2 prices.

It is important to mention, as it was and earlier that the amount of output-based allocation allowances is the factor that determines the final effect on EBITDA. Thus, this impacts both the profit on emissions and the EBITDA on cement.

To conclusion, under grandfathering allocation and for allocations over 50% of past emissions, the EU EBITDA increases. When the grandfathering allocation is 50%, then the EU EBITDA

decreases. Regarding the output-based allocation, as long as the allowances allocated is over 75% of 2004 unitary emission, the impact on EBITDA is not significant.

3.10 CO2 emissions

- Grandfathering allocation

Under grandfathering allocation, a drop in EU CO2 emissions because of the cement industry is observed. Nevertheless, half of this drop is due to the decrease in unitary emission and the other half is due to the production drop. Also, this explains the significant carbon leakage rate that was observed: In other words, half of the emissions reduction made inside the EU is compensated for by a rise in emissions elsewhere.

As time goes by and with the introduction of more carbon-efficient techniques, this carbon leakage decreases. Besides, it is important to keep in mind that no climate policy outside the EU is assumed and this is the reason for a part of this high leakage rate.

- Output-based allocation

Under output-based allocation-90%, there is no significant production drop. The whole emissions drop is based entirely on the introduction or the improvement of the carbon efficient techniques in the EU cement industry.
Again, it is repeated for clarity that some results depend on the output-based allocation: For instance, the tighter the allocation, the closer, are the EU emissions reductions and carbon leakage compared to the grandfathering allocation scenarios.

To sum up, under grandfathering allocation, the extremely large emissions reduction is partially offset by a substantial carbon leakage. Under output-based allocation, and when speaking for generous allocations, the emission reduction is much lower and so is the leakage. The tighter the allocation, the closer are the EU emissions reductions and carbon leakage to GF. For every grandfathering allocation or output-based allocation scenario, world emissions reductions turn out to be very similar.

Conclusion Effects

The truth is that the allowance allocation system of the European emission trading system is neither grandfathering allocation nor out-based allocation. It is something between them two.

Assuming that the allowance allocation system is similar to grandfathering, EU cement manufacturers will profit from an important increase in their EBITDA, but lose market share to imports. In fact, independently the allowance price, grandfathering 50% of past emissions to cement firms is enough to keep their EBITDA to the business-as-usual level. In addition, under

grandfathering allowance allocation system, there is a significant production reduction and CO2 leakage rate under grandfathering.
As a result, even though carbon dioxide emissions drops are high under grandfathering allocation in EU-27, about one-half of this drop is offset by an emissions rise outside.

On the other hand, let us assume that the allowance allocation system is the output-based allocation. Then, for an allowance allocation ratio of 90% of historic unitary emissions, even for a very high CO2 price, the effect on the production level and on the EBITDA is significant. Solely if the allocation ratio were to drop below 75% of historic unitary emissions, which is a very unlikely policy choice, would competitiveness effects (on production and EBITDA) be important (above 5%).

For any allocation ratio, abatement is reduced compared with auctioning or grandfathering, but so is leakage, and finally world emissions are almost the same.

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